OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

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"FORGED AND ROLLED STEEL PISTONS"

By W. W. Scott, Jr., Carnegie Steel Co.

INDEX—ADVERTISERS.

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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING,
NOVEMBER 27, 1914.

The regular monthly meeting of the Club was called to order at the Monongahela House on Friday, November 27, 1914, at 8 o'clock P. M., by President F. M. McNulty.

The following gentlemen registered:

MEMBERS.

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Hindman, S. M.
Hoffman, C. T.
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Howe, H.
Huchel, E. W.
Huchel, H. G.
Hudson, W. L.
Johnson, P. H.
Johnson, W. A.
Jordan, Jas. E.
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McFarland, H. L.
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McKinstry, C. H.
McNulty, F. M.
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Richardson, L.
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Ritts, W. H.
Roemer, W.
Runser, K. W.
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Ryman, F.
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Schomberg, W. T.
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Shourek, T. L.
Sheets, H. E.
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Wagner, G. R.	Yawman, C. A.
Zinsmaster, F. E.	

PRESIDENT: The call of the roll will be dispensed with, the record of attendance being taken by the registration cards.

The reading of the minutes will also be dispensed with, as they are now in the hands of the printer and will reach you in a few days.

The following applications for membership were read by the Secretary:

Bohannon, G. L., Draftsman, Pressed Steel Car Co., 176 Kendall Avenue, Bellevue, Pa. Recommended by H. L. McFarland.

Barber, J. W., General Manager, Docks & Mills, The Monongahela Consolidated Coal & Coke Co., 8 Market Street, Pittsburgh, Pa. Recommended by F. H. Stark.

Bell, Jas. E., Assistant on Engineer Corps. Penna. Lines, 266 Noble Avenue, Crafton, Pa. Recommended by D. O. Lyle.

Brosemann, W., Draftsman, Pressed Steel Car Co., 119 South Harrison Avenue, Bellevue, Pa. Recommended by N. H. Wardale.

Bruner, E. F., District Motive Power Clerk, B. & O. R. R., 26 Pecane Avenue, Pittsburgh, Pa. Recommended by D. C. Courtney.

Crawford, Don. M., Commercial Agent, Grand Trunk Railway System, 506 Park Building, Pittsburgh, Pa. Recommended by W. J. Herman.

Deane, Randolph F.,———P. C. C. & St. L. Ry., 729 Washington Avenue, Carnegie, Pa. Recommended by Wm. R. Curtis.

Denyes, P. G., Salesman, The Germain Co., 1722 Farmers Bank Building, Pittsburgh, Pa. Recommended by W. J. Herman.

Fetterolf, H. M., Representative, Patterson Sargent Co., 1605 Park Building, Pittsburgh, Pa. Recommended by H. J. Hair.

Klein, Robert A., Supervisor, Penna. R. R., Verona, Pa. Recommended by J. W. Snyder.

Mitchell, J. Wallace, Representative, Brown & Co. Inc., 10th Street, Pittsburgh, Pa. Recommended by James Neale.

McClements, J. B., Manager, Reymer & Bros., Fifth Avenue & Wood Street, Pittsburgh, Pa. Recommended by J. B. Anderson.

McCue, W. E., Assistant Foreman, Pressed Steel Car Co., 432 Island Avenue, McKees Rocks, Pa. Recommended by Harry Howe.

McMillan, William, Foundry Superintendent, Damascus Bronze Co., 35 Holyoke Street, N. S., Pittsburgh, Pa. Recommended by D. C. Courtney.

Olsen, A. Warner, Salesman, Bruckman Lumber Co., Hamilton Hotel, 712 Weiser Street, N. S., Pittsburgh, Pa. Recommended by S. D. Shook.

Pennington, F. W., Engineer, W. A. B. Co., East McKeesport, Pa. Recommended by S. W. Dudley.

Rauschert, E. A., General Foreman, B. & O. R. R., 246 Winston Street, Pittsburgh, Pa. Recommended by D. M. Howe.

Reed, George M. W., Chief Engineer, Crucible Steel Co., 1023 Crucible Street, Pittsburgh, Pa. Recommended by W. H. Ritts.

Schaich, William L., Estimator, Pressed Steel Car Co., 1233 Dickson Street, N. S., Pittsburgh, Pa. Recommended by Henry G. Huchel.

Slutzker, Joseph, Assistant Master Mechanic, Penna. R. R., 28th Street and Liberty Avenue, Pittsburgh, Pa. Recommended by F. S. Robbins.

Storer, N. W., General Engineer, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Recommended by A. G. Mitchell.

Sullivan, J. L., Foreman, Pressed Steel Car Co., Greenleaf and

Horner Street, Pittsburgh, Pa. Recommended by Harry Howe.

Streib, G. A., Clerk, Penna. Lines West, 1014 Penna. Station, Pittsburgh, Pa. Recommended by A. H. McNaight.

Wilson, S. R., Real Estate Agent, Pittsburgh Coal Co., 1135 Oliver Building, Pittsburgh, Pa. Recommended by F. H. Stark.

PRESIDENT: As soon as these names have been favorably passed upon by the Executive Committee the gentlemen will become members.

SECRETARY: I wish to announce that the paper for our next meeting will be "Notes on Transportation in Europe" by one of the officers of this Club, Mr. Stucki, and the meeting will be held on Tuesday, December 22nd, instead of Friday 25th.

PRESIDENT: Gentlemen, there being no further business we are up to the subject of the evening. The paper is on "Forged and Rolled Steel Pistons," by Mr. W. W. Scott, Jr., of the Carnegie Steel Company. It is my pleasure to introduce Mr. Scott.

FORGED AND ROLLED STEEL PISTONS.

By W. W. Scott, Jr.

Mr. President and Members of The Railway Club of Pittsburgh:

It is not the intention nor is it necessary to present in this paper, any new data as to the effect of the inertia of reciprocating parts of a locomotive upon the rails or upon the operation of the locomotive itself, but in order to freshen our memories as to investigations already made on this important subject and to prove the positive necessity for reducing the weight of reciprocating parts, it is proper at this time to review briefly the various facts brought out in the past.

Present Attempts and Results in the Counterbalancing of Locomotives.

In 1896 a committee of the Master Mechanics Association filed a report on "Reduction of Weight of Reciprocating Parts

in Locomotives" which ended as follows,—"It must be borne in mind that these designs (referring to built up pistons, wrought iron cross heads, etc.) were adopted because of their low first cost and cheapness of maintenance and the question of weight was considered of secondary importance, and your committee has not been able to learn of any method of design or construction, that has yet been brought out by means of which the weight of reciprocating parts can be materially reduced without entailing considerable increased costs over former methods of construction." In 1896 then, cost came first and weight second, but in 1914, with the tremendous increase in tonnage, weight of locomotives, wheel loads, etc., the question of weight has become as important if not more important, than first cost, and it is the intention to explain later, the methods by which the views of this committee can be met.

It is a simple problem to counterbalance the revolving parts of a locomotive to obtain a good vertical balance, and it would be an easy matter to counterbalance the entire weight of the reciprocating parts of a steam locomotive to obtain a perfect theoretical horizontal balance, but unfortunately, the vertical disturbance on the rails, always dangerous, is increased in proportion to the amount added to the counterbalance, necessary for the revolving parts. This condition has led to the practice of adding an "overbalance" varying from 30% to 75% of the total weight of the reciprocating parts, or more, to the counterbalance necessary for revolving parts alone.

The Influence of Heavy Reciprocating Parts.

So far as balance is concerned, the modern electric locomotive is almost perfect for there are no reciprocating parts to be partly or fully balanced. The connection rods where used, are "rotating links between rotating elements" and as all weights are revolving the locomotive can be counterbalanced perfectly for all speeds. Hence the draw bar pull is practically constant, the weight on drivers is constant, there is no hammer blow on the rail and the locomotive is capable of much greater speed with safety than the most perfect reciprocating steam locomotive.

As evidence of this, the record of over 130 miles per hour made by electric locomotive on Berlin-Zossen Lines in Germany in 1903, has not been equalled by any reciprocating steam engine

in this country or abroad: the fastest time for a steam locomotive of which there is authentic evidence being that made on the S. F. & W., March 1st, 1901, of 107.9 M. P. H. and that for a very short run.

It is said that the speed of a steam locomotive is limited to the steam capacity of its boiler, and to a certain extent it is true, but it is evident that any locomotive operated by steam would be liable to "jump the track" at a speed of 130 miles per hour for the reason that the vertical pressure on the rail, due to the centrifugal force of the overbalance in driver, increases as the square of the velocity regardless of what proportion of reciprocating parts weight is counterbalanced, and in every case there is a natural effort on the part of the wheels carrying the overbalance to rise from the rails at high speed. Professor W. F. M. Goss proved this to be an absolute fact through experiments in locomotive testing laboratory at Purdue University. It was also proven in the locomotive testing plant at St. Louis Worlds Fair in 1904. In the latter case the drivers of one engine actually left the rails at every revolution at ordinary high speed while every engine tested shows great variations in weight on the drivers.

In Vol. XII, Part 3, Page 65, proceedings American Railway Engineering and Maintenance of Way Ass'n 1911, are given the necessary data to figure the counterbalance disturbance of a number of locomotives typical of those in use in the United States, and it has been shown that at 80 miles per hour, a speed which is by no means infrequent for many passenger locomotives, the impact due to overbalance alone in the case of many engines, is nearly 100% ; in case of quite a number over 135%, one engine being over 152%. When the counterbalance disturbance is over 100%, the drivers actually lift from the rail when the counterweight is up, and when down, produce a true hammer blow, the force of which is actually dangerous.

Mr. F. J. Cole, while Mechanical Engineer of the B. & O. Railroad, made some interesting tests (Am. Eng. R. R. Journal, Vol. LXIII, No. 5, page 201, May, 1894, which also showed, to summarize briefly, that counterbalancing necessary to offset the weights of revolving parts and proper proportion of reciprocating parts, lifts the main drivers off the rails at ordinary high speeds (50 miles per hour for freight locomotives). In making

a comparison in effect between "light" and "heavy," comparatively speaking, reciprocating parts, he uses the following:

"Eight (8) wheeled engines having four (4) coupled drivers and four (4) wheeled trucks.

	Diameter Drivers	—60″
	Size Cylinders	—18″ x 24″
	Weight on Drivers	—72300 pounds
	Steam Pressure	—160 pounds
Weights of Reciprocating Parts:		
	Piston and Rod	—285 pounds
Heavy 634 pounds	Cross Head	—138 pounds
	One Half Main Rod	—211 pounds
		634 pounds
	Piston and Rod	—219.56 pounds (using solid plate piston)
Light 420 pounds	Cross Head	— 92.73 pounds
	One Half Main Rod	—107.50 pounds
		419.79 pounds

and shows that at 60 miles per hour, the alternations of weight during one-half revolution for heavy parts is 63920 pounds the actual weight on the drivers being 40340 pounds minimum and 104260 pounds maximum, as compared to alternations of weight during one-half a revolution for the lighter parts 45592 pounds, the actual weight on drivers being 49504 pounds minimum and 95096 pounds maximum. These determinations were made before rolled and forged pistons, and hollow piston rods were in vogue. Doubtless the reciprocating parts could now be designed to be much lighter than 419.79 pounds.

It is necessary, of course, to balance the reciprocating parts so that the engine will not buck or plunge and will have a fairly constant draw bar pull but in the light of present day knowledge, the old idea of using heavy reciprocating parts simply because they are strong and cheap, seems like putting the cart before the horse. It is evident without argument, that the maximum weight on drivers should be figured for a higher speed than the locomotive makes on ordinary runs, because the static driver load in steam locomotives, unlike that in electric

locomotives, is no indication whatever of the blow transmitted to the rail at speed, and has little to do with the effect on track, unless the static load is excessively high and causes a crushing of the rails due to rotating effect. The important fact is that the overbalance in the driver, hammers the rail when the locomotive is in motion. The greater proportion of broken rails occur during freezing temperatures. Many of them are diagnosed as "crystallized." Let it be here stated that rails do not crystallize: such rails are broken by the centrifugal force of the overbalance coming at a time when the track is frozen rigid and cannot cushion the shock. To reduce the overbalance blow is to reduce the number of broken rails.

THE ADVANTAGES OF THE ROLLED STEEL PISTON.

(a) In Reducing Weight of Reciprocating Parts.
(b) In Reducing Cylinder Wear.

Would it not be wise to rule that no locomotive (let us say passenger at 70 M. P. H.; freight at 45 M. P. H.) shall have an impact on rail due to overbalance of more than 30% of the static weight on the drivers? This is much better than the ordinary American practice although it is strictly followed by the Pennsylvania Lines East of Pittsburgh whose maximum weight on one driving wheel is 32,500 pounds. No engine is allowed to show more than 30 % dynamic augment (at the speed mentioned) or 9,750 pounds per wheel. That such a rule is not a hardship is proven by the fact that some of the German Railways allow only 15% dynamic augment at high speeds. When one considers the fact that in this country, the average is about 62½%, it is high time that it be reduced.

Having made the rule referred to, it will be an easy task to work back to the allowable weights for reciprocating parts; it will at once be seen that the ordinary piston rod, piston crosshead, and main rod will not do; that it will be necessary to go deeper into designs and stresses than was the custom when lighter locomotives were in common use; it will be found that a rolled and forged piston will be from 10 to 60% lighter than the old types; that boring the piston rod will reduce its weight about 25%; that the substitution of a good alloy steel for ordinary steel will reduce the weight of cross head from 10

to 30% ; that *I* shaped main rods are not only lighter but stronger than those of rectangular cross section.

Through the courtesy of Mr. J. T. Wallis of the Pennsylvania Railroad, the formula for calculating counterbalances required at tread of driving wheel for Pennsylvania Railroad locomotives, is here given:

Method of Calculating Counterbalance Required at Tread of Locomotive Driving Wheel for Road Service.

The Maintenance of Way department has limited the maximum dynamic augment at 70 M. P. H. to 9750 pounds per wheel, which is 30% of the maximum weight of driver on rail.

Wr = Total weight in counterbalance at radius (r).
W_R = Total weight in counterbalance at radius (R).
W_1 = Weight revolving parts in pounds, per wheel.
W_2 = Weight reciprocating parts in pounds, per wheel.
R = Radius driving wheel in inches.
r = Radius crank pin circle in inches.
g = Acceleration of gravity in feet *per sec. per sec.* = 32.2
$100x$ = % reciprocating parts balanced.
xW_2 = Weight in counterbalance (Wr) above that for revolving parts.

$$Wr = W_1 + xW_2 \qquad \text{and } W_R = \frac{r}{R}(Wr).$$

$$n = \text{Number revolutions per second} = \frac{\text{R. P. M.}}{60}$$

$$\text{Dynamic Augment} = \frac{4\pi^2 r n^2 x W_2}{1.2\,g} = 9750.$$

$$\text{Whence } xW_2 = \frac{9544}{r n^2}$$

$$\therefore Wr = W_1 + \frac{9544}{r n^2}$$

$$\text{and } W_R = \left(W_1 + \frac{9544}{r n^2}\right)\frac{r}{R} \text{ — Desired at tread of wheel.}$$

This formula is based on dynamic augment of 30%. If it is desired to work lower than 30%, the figure 9,750 pounds shown above can be changed to agree with percentage of driver load agreed upon.

For the benefit of those who may desire to calculate the dynamic augment of locomotives already in service, constants worked out by Baldwin Locomotive Works will be useful and are here given. (It must be borne in mind that these figures have been worked out on the basis that speed in miles per hour equals diameter of driver in inches.)

Illustration: 26″ Stroke
60 M. P. H.
70″ Diameter Driver

$$\text{Dynamic Augment} \quad 41.7\ W\ \frac{60^2}{70^2}$$

Stroke	Dynamic Augment	
18″	29.1 x W	
20″	32.3 W	
22″	35.5 W	
24″	38.5 W	
26″	41.7 W	At Diameter Speed
28″	44.9 W	
30″	48.4 W	
32″	51.7 W	
34″	54.9 W	

W = Excess weight at stroke distance.

A rule making necessary the reduction of reciprocating weights may, at first thought, seem to be a hardship but a little reflection will show that to do otherwise, even though it adds a trifle to the first cost of the locomotive is to be "penny wise and pound foolish." (Let it be stated here that a rolled and forged steel piston will not increase the cost of a locomotive.) The value of all the reciprocating parts in all locomotives in this country probably does not exceed 1% of the value of the rails in track and it is positive economy to save the greater investment in rails by lightening the weights of reciprocating parts which represent the smaller investment.

In this progressive age, it behooves every man to ascertain how his decisions affect his entire business and not one particular department. It develops then into the question whether it is cheaper to lessen the dangerous blow on the rails by lightening reciprocating parts, or increase the weight of rail. One thing or the other must be done in the near future.

As evidence that the question of lightening reciprocating parts is beginning to receive the attention it deserves, it is only necessary to mention two specific cases recently described in the technical papers. The first is that of the Pennsylvania Railroad which, at its Altoona Shops, has recently developed the efficient types E6s—K-4 and Ls locomotives. They are worthy of most careful study by engineers and laymen interested in steam engines; their reciprocating parts are said to be the lightest ever used in an American locomotive having the same size cylinders. The pistons are of one piece solid, forged and rolled from 35 to 50% O. H. Steel untreated, made by the process about to be described, and are almost 50% lighter than the type which they superseded, the piston for E6s (4-4-2 Type) 23½" cylinders weighing 144 pounds finished. Each piston carries two packing rings of cast iron sprung into their grooves in the usual manner. Although very light, they have proven their ability to resist extraordinary shocks, because, while the type of piston having a cast iron bull ring bolted to a cast steel center sometimes fractures during very low temperatures on account of steam condensing in the cylinders, the solid rolled steel piston has given no trouble under exactly the same conditions; in fact, one case was reported where the shock, instead of bending or breaking the piston, was transmitted to the main rod which bent three inches out of line and worked in that condition to the end of the division where the deflection was detected.

The other case is that of 2-10-2 freight locomotives built by Baldwin Locomotive Works for Chicago, Burlington & Quincy, cylinders 30" diameter, 32" stroke. In 1912, several of these locomotives were built which proved their efficiency, but the revolving and reciprocating parts were so massive that the drivers (60" in diameter) could not accommodate the proper counterbalance and it was found necessary to key a counter weight or "bob" weighing about 3000 pounds to the main axles, the main wheel being heavy on pin side 590 pounds even with the "bob."

These locomotives were duplicated in 1914 in all respects except that the weights of reciprocating and revolving parts in two of them were reduced so that not only was the counter weight on main axle unnecessary, but the counterbalances in the drivers were reduced about 4000 pounds making a saving in dead weight of about 7000 pounds each, the rated tractive effort (71500 pounds) remaining the same and although the main driver is still heavy on the pin side, the weight has been reduced 35 pounds making it 555 pounds instead of 590 pounds. The total weight of reciprocating parts in the locomotives having "bobs" on the axles, is 2315 pounds: in the locomotives without "bobs," 1936 pounds. The reciprocating parts are about 16% lighter in the latter.

The pistons of the lighter locomotives are Z type: the steel center being riveted to a cast iron bull ring carrying two packing rings. It is probable that the weight of reciprocating parts might have been still further reduced had a solid piston been used.

It is interesting to note in passing, that the P. R. R. locomotives mentioned, as well as the lighter C. B. & Q. locomotives, are fitted with bored piston rods and that the main and side rods are I-Beam section while the driving and trailing axles on the P. R. R. locomotives are bored from one end to the other to facilitate quenching and tempering.

Method of Manufacture.

If, then, the decided advantage of lightening reciprocating parts has been proven, it is interesting to note that a new method of manufacturing pistons has been developed by means of which a saving in weight of 10 to 50% or possibly more for certain types, can be accomplished. The process has been worked out by the Carnegie Steel Company at its Homestead Car Wheel Plant where, among other circular sections, pistons are made practically from "ore to finished product."

The ingots are cast according to usual open hearth furnace practice in moulds 22" x 22" and about 6 to 7 feet long. After stripping and soaking in the furnaces at Blooming Mills in the customary way, the ingots are rolled into round blooms 15" in diameter (See Fig. No. 1) and, while hot, (See Figure No. 2) sheared into discs or "cheeses" of the proper weight to produce

the required section by further forging and rolling to be described later.

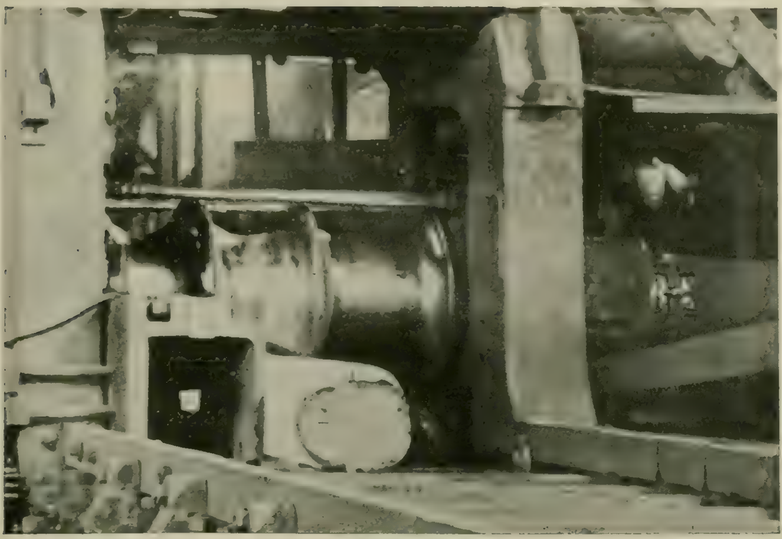


FIG. 1.

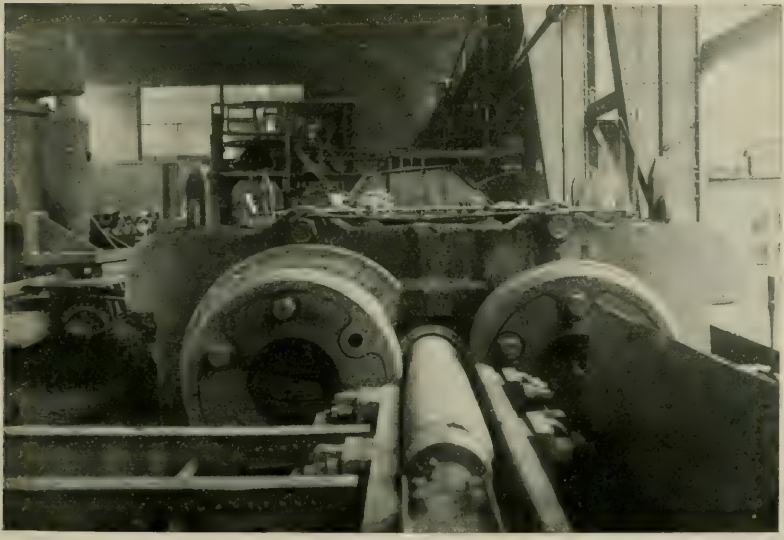


FIG. 2.

At this point your attention is called to the forging and rolling work done on the steel used, through the reduction of a

22" x 22" ingot into a 15" round in the Blooming Mill. This reduction represents a very important refinement of the rough cast ingot into a forged product of uniform and sound structure, which is far superior in its adaptability for the final forging operations than a raw casting of steel.

There may arise in your mind, the question why these blocks are sheared from rolled rounds into the form of discs rather than from flat slabs into the form of squares, as made for annular sections at Homestead and other plants some years ago.

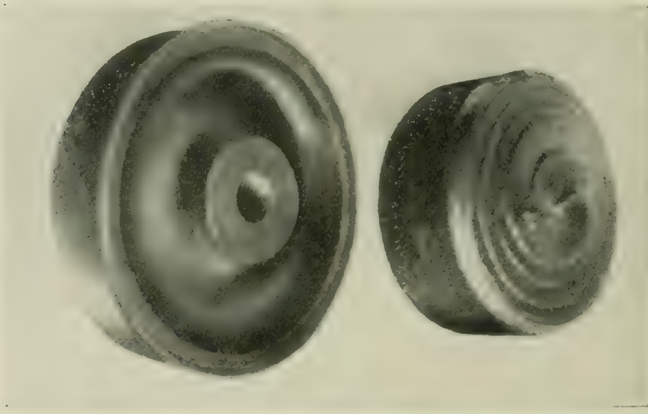


FIG. 2A.

(See Figure No. 2A) The answer is the keystone of the present day success of rolled steel sections such as passenger, tender and freight wheels, gears for electric railways, heavy duty double flange crane track wheels, etc., and lies in the fact that the outside of the ingot which, according to the nature of the elements composing it, is its best part, finally becomes by this process, the outside or periphery of the section while the center, naturally the weakest part, eventually becomes the core and goes back into scrap. It is, of course, understood that sufficient discard has been made from the rolled round bloom to insure freedom from piping.

The discs when cold, are carefully inspected (See figure No. 3) for surface or rolling defects and any present are either chipped out cleanly by means of pneumatic chippers, or the disc is scrapped. From the Inspection Yards, the discs are taken to the wheel plants and in the case of pistons, gear blanks, and other sections lighter than freight, tender and passenger wheels,

are heated in a continuous gravity furnace insuring the rolling of each disc in its proper order at a uniform heat (See Figure No. 4.)

FIG. 3.

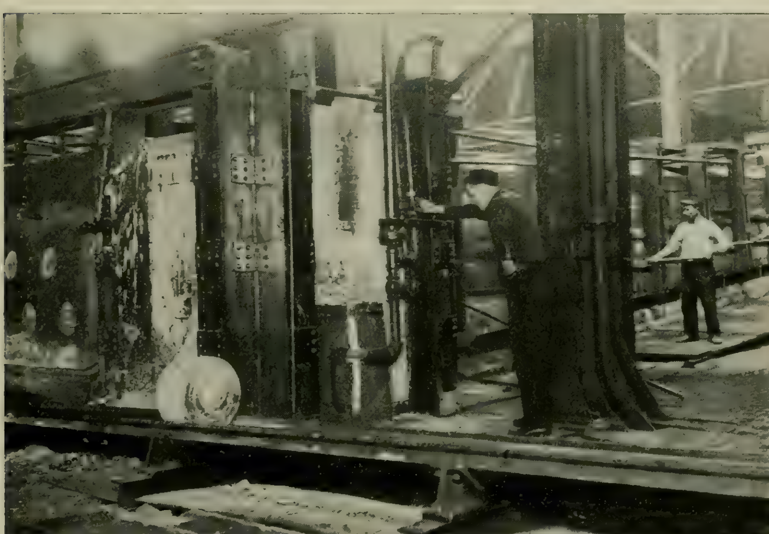


FIG. 4.

By means of a steel dog running between two rails, the disc

is transferred to a hydraulic press whose function is to pierce a hole considerably smaller than the rough bore desired about half way through the center on the axis of the disc in order that the disc can be held between the rolls, on a pin, until the hydraulic pressure applied grips the piece and forging commences (See Figure 5). The Mills were designed and patented by Mr. E. E.

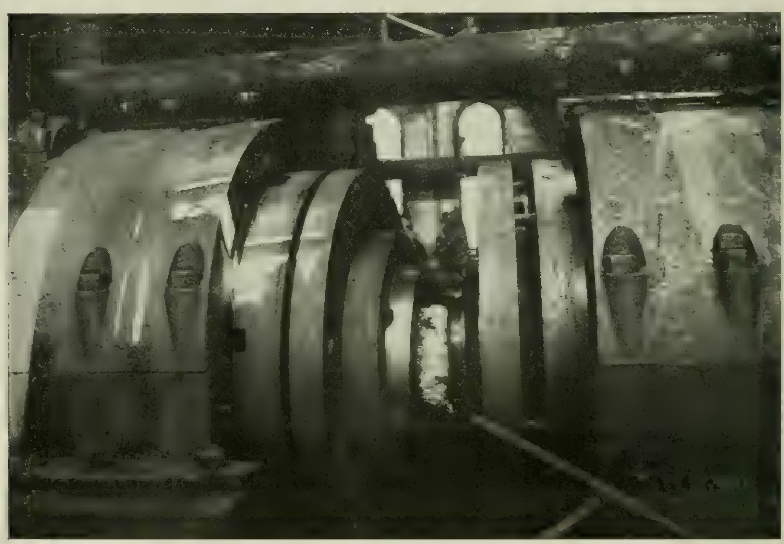


FIG. 5.

Slick and are unique in that they are the first of their kind ever built and are original in every respect. Each mill, of which there are two, is composed of two rolls or dies facing each other, set on the ends of two shafts which are out of line; one mill having the shafts approximately 14° and the other approximately 7° out of parallel. It is evident therefore that when the dies are brought together before the shafts turn, the disc is subject to a forging action. When sufficient forging has taken place under a hydraulic pressure starting at about 700,000 pounds and intensified to 3,000,000 pounds maximum at the finish in the larger mill, to start the piece into the contour of the die, steam power furnished by a 2500 H. P. engine is applied to revolve the roll shaft and from this point until the piece is taken from the rolls, it is subject to both rolling and forging action which insures close grained, well worked metal.

In passing, it is interesting to note the extra heavy equip-

ment necessary to work steels as high as, in some cases, 95 carbon, into annular sections.

Bed Plates Weigh	—164,000 pounds
Entire Weight Including engines	—1,200,000 pounds
Size of Die Shafts	—31″
Size Hydraulic Cylinders	—40″ dia. x 24 stroke
Outside Diameter Rolling Bearing	—6′ 0″
Diameter of Die	—5′ 10″
Size of Rollers	—5″ dia.

After rolling, the piece is put through a shear which automatically frees it of the "flash" which is usually present in a flat forging. In the same machine, the core previously mentioned as having been in all cases the center of the ingot, is punched out (See Figure No. 6) to make the rough bore thus freeing the steel of any undesirable segregation that may happen to be present after the discard from the round bloom has been made at the Blooming Mill shears.

FIG. 6.

An experiment was made to trace the movements of the center of the ingot during the process of manufacturing an annular section. A bar of copper 1″ in diameter was inserted

in a hole drilled through the axis of the disc while cold. The disc was heated and worked in the usual manner. After the core had been punched out, it was split longitudinally with the copper bar. The latter was found to have varied from its original position slightly less than an inch; the maximum variation from the center line occurring about half way through the section, indicating that the steel had been thoroughly worked all the way through.

After punching the bore, the piece is rough turned on the periphery, on the edges of the rim and on both faces of hub in order that any scale or surface defects may be eliminated and clean sound metal assured.

After passing final inspection, the product is ready for shipment. The method just described refers only to plate pistons.

Solid plate pistons are not new, steel casting in this form having been used as long ago as 1900 in Europe and are now used more or less extensively in this country in low pressure cylinders of compound engines where the diameters are such that the weight of a box or double wall piston would be prohibitive. This brings to mind the interesting question of the wear of the piston against the cylinder. It is commonly believed that pistons wear the bottom of cylinders, but a close investigation will show that a fair percentage of cylinders wear on the top, due in part, to improperly lined guides, loose cross heads and to

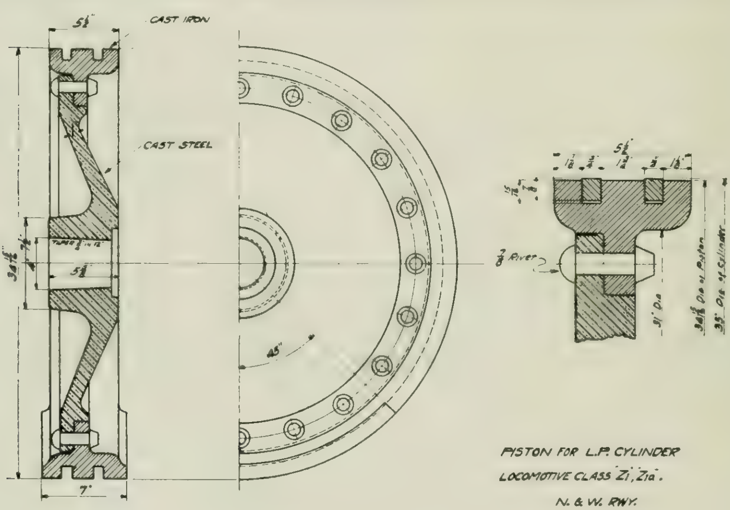


FIG. 7.

the fact that when the locomotive is working under steam, the pressure works first under the piston rings and tends to throw the piston upward against the top of the cylinder. It is no doubt true that a steel piston working in a cast iron cylinder will score or cut the latter *if they come in contact* and with this contingency in mind, almost all American designing engineers bolt or rivet a cast iron bull ring to a steel center (See Figure No. 7), the former being provided with grooves for cast iron piston rings.

Construction Recommended.

There have been some noteworthy diversions from this practice however, particularly on locomotives operated by the Norfolk & Western Railway. One method is to pour molten iron (See Figure No. 8) into a groove machined in the face of the piston. Another is to pour molten bronze in the same manner (See Figure No. 9), afterwards turning in a lathe to the proper diameter. Both of these types are said to operate efficiently but it is not the easiest task in the shop to replace the worn down bearing surface as the shrinkage of metals must be well understood by the workmen in order to get a tight fit. It

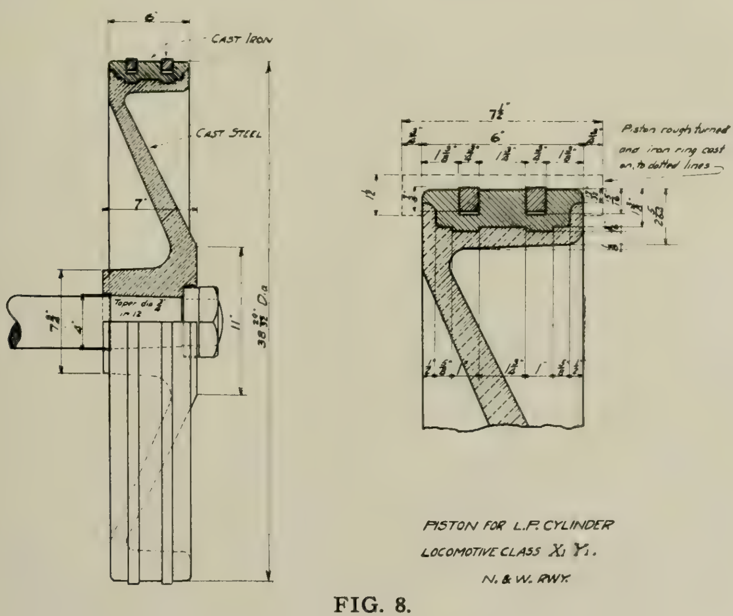


FIG. 8.

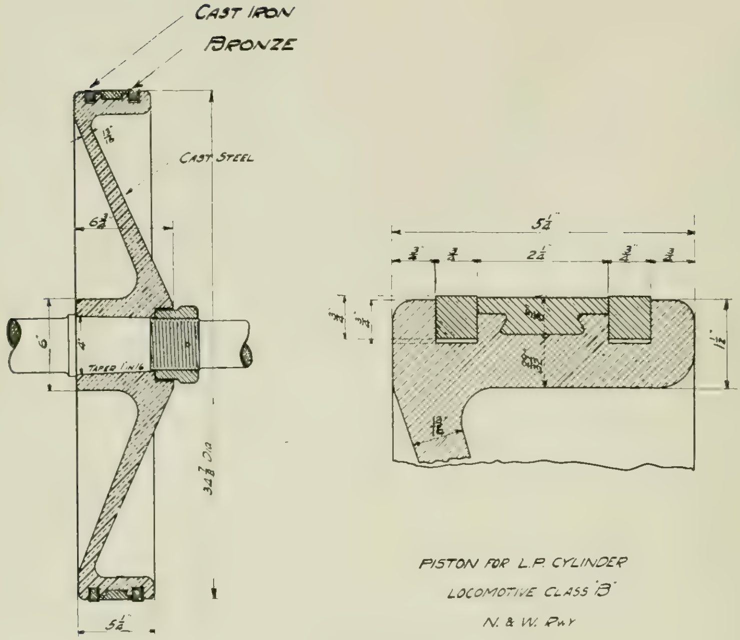

CAST IRON
BRONZE
CAST STEEL
TAPER 1 IN 16
PISTON FOR L.P. CYLINDER
LOCOMOTIVE CLASS 'B'
N. & W. RWY

FIG. 10.

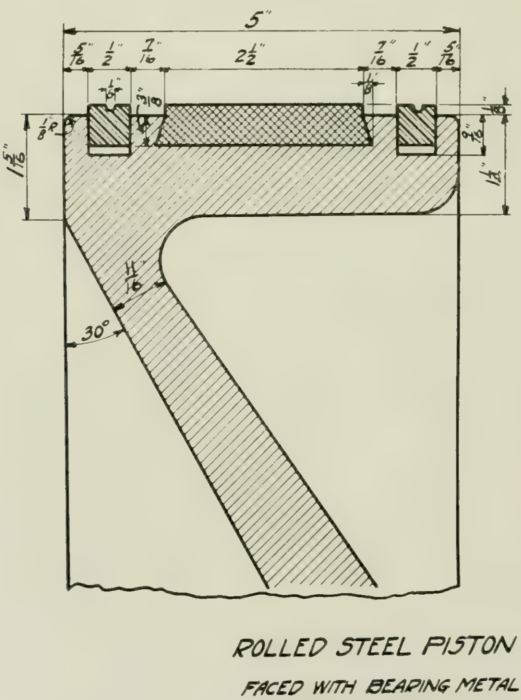
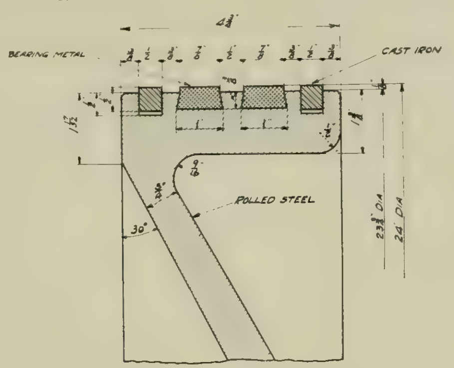

ROLLED STEEL PISTON
FACED WITH BEARING METAL

FIG. 9.

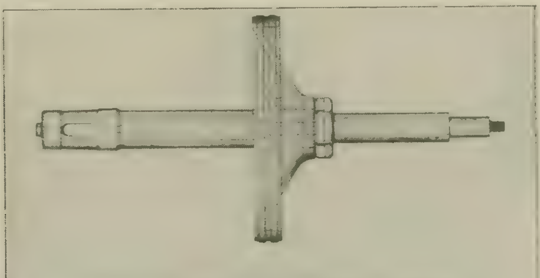
is suggested here, therefore, that the practice followed by designers of heavy stationary engines be followed in using solid rolled steel pistons in locomotives. That is, to cut one or more dovetailed grooves in the face of the piston, insert segments of good malleable bearing metal and hammer it solidly into the dovetailed grooves (See Figure No. 10). This has the added advantage of forming an oil groove or pocket between piston rings and bearing metal face. It has also been found that bearing metal in face of piston, polishes the cylinder walls thus facilitating lubrication. Another suggestion is two rings of bearing metal. (See Figure No. 11)



PROPOSED ROLLED STEEL PISTON
HAVING BEARING SET IN FACE WITHOUT EXTENDED ROD

FIG. 11.

The solid rolled steel pistons for the Pennsylvania Railroad just described (See Figure No. 12), are used with extended rods which have the advantage of reducing cylinder wear and



ROLLED STEEL LOCOMOTIVE PISTON
AND
HOLLOW PISTON ROD

FIG. 12.

simplifying lubrication. The extended rods in use some years ago, which were discarded, are not to be compared with those in use on the latest types of engines, for the old rods and pistons were much too heavy, the pressure on front bearing being as high as 50 pounds per square inch while the new type of extended rod has a pressure on the front bearing of only 10 pounds per square inch.

The old types of extended rods were of no particular value in saturated steam locomotives where good cylinder lubrication was comparatively easy to obtain. With superheated steam, however, a very different condition prevails as to cylinder lubrication and it is the part of discretion to prepare for the contingency that when the engine is drifting long distances, the cylinders may not be properly lubricated.

If then there may be times under certain conditions when the cylinder is comparatively dry with the piston riding on the cylinder, it is certainly better practice to have an anti-friction metal in contact with the cylinder rather than even the best of cast iron, so that wear will be reduced to a minimum and scoring eliminated.

For this reason it is recommended that solid steel pistons (unless supported by an extended rod) be faced as before mentioned with a bearing metal that will not only stand a temperature of 618° F., but will also be malleable enough to permit of hammering in segments into dovetail grooves. We have made laboratory tests of a new bull ring metal which showed an "exuding" point of 1150° F., an average scleroscope hardness of 8, and which can be easily peened into a dovetailed groove $\frac{1}{4}''$ to $\frac{3}{8}''$ deep.

This is not an experiment, for pistons as large as 50″ in diameter, faced with bearing metal, are in use in many of the heavy duty rolling mill engines in the vicinity. Such a piston weighing 3400 pounds may be found in operation at the Homestead Steel Works.

Time and test will prove whether the bearing metal mentioned will stand the ravages of superheated steam but it is safe to assume that if it will not do, another bearing metal can be developed which will be satisfactory. We have known for many years that the proper kind of bearing metal will reduce

friction and losses by friction in locomotive cylinders are more than a mere trifle.

It has been suggested that rolled and forged pistons be faced with a cast iron ring like piston rings except wider, set in a groove ⅛″ less in depth than the thickness of the ring; the ring to be halved, or in three segments, and when assembled in piston, to be slightly less in diameter than the cylinder. This scheme should work whether the bearing rings are fastened to the piston or simply held in places by the cylinder walls. It has a distinct advantage in ease of replacement of bearing face as well as being economical.

Many ways can be worked out by which a forged and rolled steel center can be attached to cast iron bull rings, such as the use of retaining rings or spring keepers, but if cylinder bushings or cylinders are to be protected against excessive wear, an anti-friction face is the logical progression. It is, of course, impossible to roll a box piston or any other kind than one having a single plate. It is possible to roll centers that are intended to carry a cast iron bull ring but the tendency of the times is to reduce the number of parts as well as the weight, and therefore the solid forged and rolled steel piston takes its place as the latest development in this line.

PRESIDENT: Gentlemen, the paper is now open for discussion.

MR. T. T. COPELAND: Mr. President, with regard to forged and rolled steel pistons, it has been shown that the weights of the reciprocating parts can be greatly reduced without weakening the locomotive or increasing its cost. Steel pistons are being used in a 65 ton switching locomotive at the Homestead Plant of the Carnegie Steel Company and have proven very satisfactory.

The cylinders on the locomotive I refer to are 20″ x 26″, the left cylinder was re-bored, and in the right cylinder the piston was fit to the cylinder which was worn about 1/32″ on the bottom of cylinder.

A soft metal 7/16″ x 1⅝″ dovetailed in the walls of the piston 13/16″ from the packing rings and extended 1/16″ by the walls of the piston in order to prevent the steel piston from bearing on the cylinder.

The weight of cast iron pistons used prior to the steel pistons was 279 pounds, weight of steel piston 175 pounds, or a difference of 104 pounds, per piston.

This locomotive made about 1370 miles, pistons were removed and examinations showed no wear on soft metal.

MR. B. F. FAUNCE: Mr. President, we have manufactured several hundred piston heads, very successfully, and turned out a very good product, and to the satisfaction of our customers. We reduced the weight very materially from anything that they had previously used in the same type of engines.

The following might possibly be of interest to those who use castings and not the forged product; I understand that where the discard or the loss in steel castings was over 15%, that the loss on those we furnished was considerably under one per cent. There was but one piston rejected out of several hundred. I understand that the cost of machining the rolled steel piston is less than the cost of machining the same piston from a rough steel casting.

The forged piston comes free from physical defects; there is no sand nor blow holes; but good, solid, homogeneous material.

These pistons can be furnished in diameters, ranging from 12″ to approximately 34″, providing the design is such that they can be forged. There may have to be some changes in the design of cylinder heads, in order to use this type of piston.

MR. F. E. COOPER: The design of the forged steel piston looks pretty good in several respects. There is trouble in the old cast steel piston of the follower bolts coming out. In this piston there is nothing to come loose at all. The trouble is in getting a metal as a wearing strip that will stand the superheating, and if that is overcome I think it is a pretty good piston.

MR. H. H. MAXFIELD: Mr, President, I do not feel that I have very much to add to this discussion this evening. The speaker, I think, has brought out very clearly the Pennsylvania practice on this solid steel piston. We have on the Pittsburgh division quite a number of the L1s engines, equipped with this type of piston but we have not had them in service a sufficient length of time for me to be able to say anything as to the performance of these pistons, though personally I am

thoroughly satisfied that they are going to be successful in every way. The E6s locomotives which have been referred to are in service almost entirely on the divisions east of Altoona and, as far as I know, are giving splendid satisfaction.

I would like to ask Mr. Scott to explain in connection with the piston rod, just why the bore is not uniform.

MR. SCOTT: When first forged, extra metal is allowed on outside of piston rod on both ends and at piston seat. The rod is then bored same size hole from end to end and reforged to general shape shown on sketch, which thickens the walls and decreases the bore where excess metal was left in first forging.

MR. MAXFIELD: Was that done to give strength at those points?

MR. SCOTT: It gives strength where strength is needed.

MR. MAXFIELD: We use the extended piston rods, and while I am not particularly in love with the extended piston rods, at the same time in this case it seems to me it is preferable to the use of the bearing metal. I am afraid that with the use of the bearing metal, especially with the superheated locomotive, you are going to run into trouble on account of the metal melting out. While it is true when the piston is originally put in service it would probably be at a main shop and no doubt the mixture of the metal would be chemically correct and the process of applying it would be exact, yet, in the case of repairs, in a great many instances, the work would have to be done at outlying points and you would stand a pretty good chance of running into inferior metals and poor workmanship in getting the metals in. Therefore I think that the extended piston rod is the best solution.

MR. THEO. HERMANSON: There is one point I would like to be clear on. In using this style piston is it not necessary to change the design of the heads, that is, to put this type of piston in the present locomotive, is it not also necessary to put in a new type of head.

MR. SCOTT: It is necessary to change the heads and therefore, it is suggested that the light forged and rolled steel piston be arranged for in designs for new locomotives. It is rather a difficult job to fit such a piston to old equipment but

it is a simple matter to design the cylinder heads in new equipment to fit the piston. We will be glad to co-operate with any railroad in designing a light forged and rolled steel piston to be applied to new locomotives.

MR. N. W. STORER: Mr. President, I don't quite see that I can add anything to the discussion this evening. The only excuse I could have for speaking would be to bring in the subject of electric locomotives which has been touched upon very briefly in the paper, but the discussion at present seems to be centered more on cross-heads and other objectionable features in the steam locomotive, all of which are lacking in the electric locomotive. There are, however, a few questions that arise in my mind on which I should like an answer from some of the many experts who are here. What is the effect of the hammer blow from the unbalanced reciprocating parts on the rail? Does it produce an indentation? Does it bend the rail or does it produce its worst effect on the road-bed? I should also like to know what is the effect on the rail from the driver weights which are now used by some railroads—say for instance, 32,500 pounds per wheel? Does that tend to roll out the rail head and how much does it add to the cost of maintenance of the road-bed over what would be required if the same total weight on drivers were distributed among 25% more wheels without adding to the rigid wheel-base? Also I should like to know what is the difference in effect on the rails between large drive wheel and small one having a given total weight applied to them?

PROF. L. E. ENDSLEY: In regard to the effect on rail of the unbalanced weight or that part of the counter balance which is added to balance a certain percent of the reciprocating parts, I will say that you can add enough of this weight to lift the wheel off the rail if the speed is high enough. In some tests carried on some years ago on the first locomotive at Purdue, it was found that 400 pounds in excess of that necessary to balance the revolving parts will cause the locomotive driver to leave the rail at a speed of 310 revolutions per minute or for this locomotive that had drivers of 63 inches in diameter, was 58 miles per hour.

This 400 pounds was considered at the radius of the crank which on this locomotive was 12 inches. The actual weight was less than 400 pounds as the radius of the center of gravity of

the counter balance was somewhat greater than the crank radius. On the modern locomotive it would require, however, probably twice 400 pounds to lift the wheel from the rail as the weight on the driver on which these tests were made was only 14,000 pounds per driver and some of the modern locomotives have twice that. So that in the present locomotive we would have to be rather careless in the counterbalancing of the locomotive in order to lift the wheel from the rail. Especially is this true when we consider that we have a greater number of drivers on most locomotives, to distribute the weight among. The locomotive upon which these tests were made was an American type which had four drivers.

The method of conducting the tests referred to was to pass a small wire thirty-seven thousandths of an inch in diameter between the driver and the supporting wheel of the testing plant. By having the driver notched at two places, 90 degrees apart, with chisel marks of distinctive character, the impression on the wire could be connected up with the position of the counterbalance. It was found that the driver left the carrying wheel usually just after the counterbalance passed its vertical position.

I am sure that we are all very much interested in anything that will lighten the reciprocating parts and this piston seems a step in that direction. Also the inserting of the composition ring of metal around the piston may be something that will more than pay for the expense as it no doubt will save the wall of the cylinder should the piston get in contact with the cylinder. I, however, do not see how you could gain much in a cylinder that was worn elliptical, you might make this part of the piston fit the cylinder very closely by hammering the composition metal to fit the cylinder. But what are you going to do about the rings?

I am very glad to have been here tonight and I think Mr. Scott has shown us very clearly how these pistons are made. It no doubt would be very interesting to see the operation but we have seen it as near as we possibly could without being actually at the mill.

MR. W. L. HUDSON: Mr. President, I don't know that I have anything to say. I am not a designer; I am an operating man. Anything that can be done to reduce the weight and

at the same time increase the efficiency of the reciprocating parts will be graciously accepted.

MR. A. W. BYRON: As I understand it those pistons are finished all over to size. Is that right, Mr. Scott?

MR. SCOTT: Yes; they are finished on all surfaces.

MR. BYRON: Is it possible to roll them particularly in the plate to finished size in order to save machining?

MR. SCOTT: No; so many different sections are required that the mill cannot run any great length of time on one particular section and consequently there is a variation in the product as rolled; roughly, the variation from the finished size is about as much as a steel casting would have, possibly a little less in some cases.

MR. L. RICHARDSON: I would like to ask how high that wheel rises off the rail—for what distance?

PROF. ENDSLEY: Some of the tests where we had, 400 pounds unbalanced vertical force, the wheel remained off the rail as much as 40 inches (travel of the wheel). I think the maximum distance was 42 inches. As to how high it went, I cannot say.

MR. RICHARDSON: Now in actual practice on a railroad, do you really believe that the wheel leaves the rail? Don't you think the spring of the track causes it to follow that wheel and prevent the hammer-blow?

PROF. ENDSLEY: The wheel no doubt would not leave the rail as far as it would the supporting wheel in the laboratory but the difference in pressure would be there just the same. I wish to make it clear that in order to get the wheel to leave the rail in the laboratory tests, an excess of unbalanced weights was added. In fact all of the reciprocating parts were fully balanced and 66 percent of this was applied to one wheel. So that in actual service in my opinion, no locomotive would ever leave the rail under present running speeds.

MR. G. M. EATON: Mr. Storer requested a statement of the damage effected on the rail by an over-counterbalance. Some years ago the Baldwin Locomotive Works were conducting a trial run of a locomotive on the customer's tracks. The greater part of the track consisted of 80-pound rail, but a certain portion had been recently re-laid with 100-pound rail. Dur-

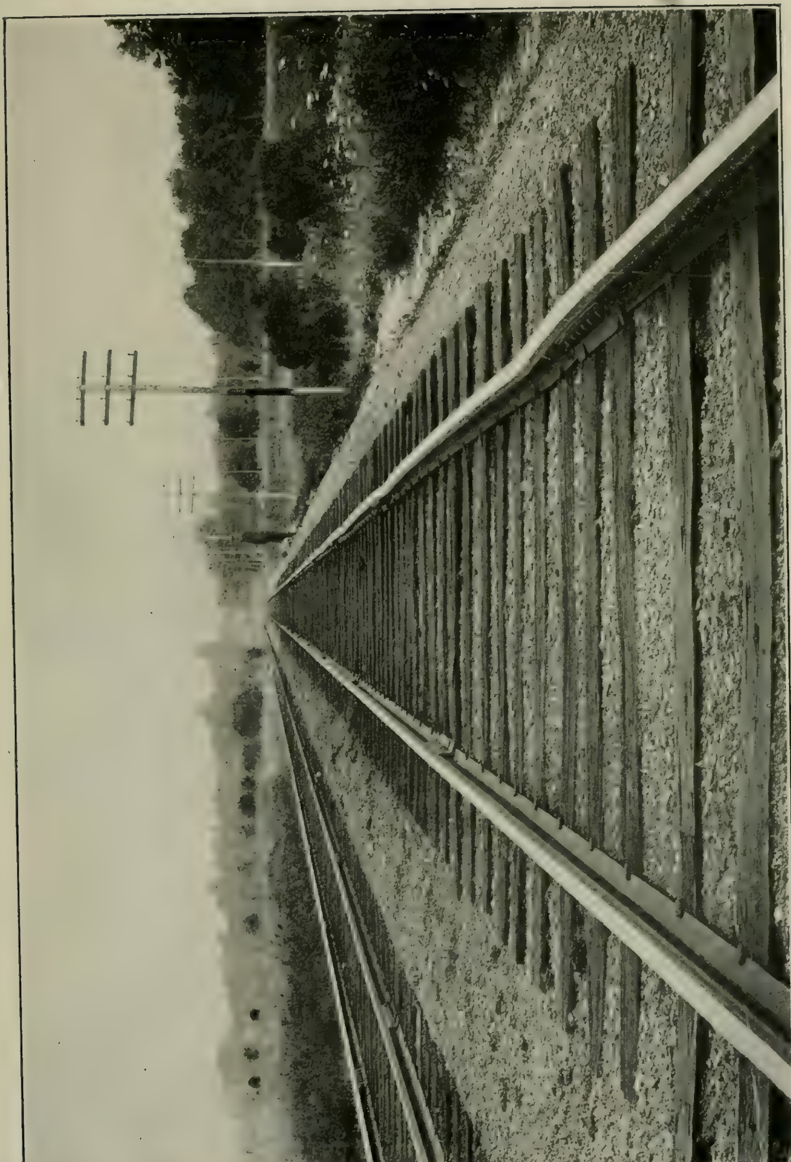


FIG. 13.

ing the test, a very high speed was attained on the 100-pound section, and the operation on this heavy rail was apparently satisfactory. As soon, however, as the locomotive ran onto the 80-pound rail a very decided disturbance was caused. The counterbalance produced a blow heavy enough to bend the rail toward the center of the track, the results being shown in (Figure 13.)

Mr. Scott stated in his paper that the pistons were normal steel. I should like to ask whether these pistons were annealed and would also like to ask whether it would not be feasible to still further reduce the weight by heat-treating the pistons. Great stress is laid in the paper on a weight reduction of one or two-hundred pounds, and apparently every pound removed represents a great gain. It seems to me quite illogical to revamp a considerable proportion of the design of a locomotive on the basis of rolled steel pistons and at the same time fail to go the limit of the art as it stands today. There is a large volume of experience to draw from in heat-treating sections such as these pistons, and I believe it will be only a short time before the designer who uses a normal steel piston made by the rolled process will see his design superseded by a heat-treated piston.

MR. SCOTT: The pistons in service have not been quenched and tempered or annealed. Personally, I do not think heat-treating would be of any advantage to the piston as the sections as now used are about as light as they should be, the plate of the smaller piston illustrated being 1/2″ thick immediately under the rim. In my opinion, it would not be feasible to reduce this dimension to any great extent by any form of heat-treatment. Heat-treatment would seem to be an unnecessary expense in this instance.

MR. HERMANSON: In looking over this new type of piston, one sees that it is without a doubt a better piston than the solid type, providing a proper method is used of fastening the follower to said piston.

The Marine type piston, which has been used for a number of years and is made of cast steel, is pretty much the same type as this shown here tonight. They use the following method of securing the follower:

The studs are made with a shoulder and the piston is counterbored to the size of that shoulder and deep enough that when said stud is screwed into the piston the shoulder comes flush

with the face of the piston, so that when the follower is put on it has a bearing surface not only on the piston surface, but also of the shoulder of that stud, and it is therefore impossible for it to work loose.

The follower is screwed on with an ordinary nut and the nut is secured sometimes by drilling a hole through the nut and stud and one continuous wire inserted through all the nuts around the whole circle, thus making it impossible for a stud or nut to ever work loose.

This method enables the railroads to use this type of piston without any danger of working loose.

MR. A. STUCKI: The subject has been pretty well covered so that I haven't much to add. However, I wish to emphasize as strongly as possible that the reciprocating parts cannot be counterbalanced, properly speaking. You cannot do it. Prof. Endsley already made some remarks to that effect.

If you counterbalance all of the reciprocating parts, you have no horizontal blows on the shoes, but you have the full blow up and down, and if you would counterbalance none of the reciprocating parts, you would take the whole blow by the shoes and you would have ideal conditions for the rail as you would have absolutely no blows vertically, but we cannot have both and all we can do is to divide the disturbance, so as to make it tolerable in each direction. The heavier the locomotives are made, the heavier, generally speaking, the reciprocating parts will be, which means that we have to endure heavier blows, and I am sure that most of our rail trouble is due to this very item. For this very reason I was glad to listen to Mr. Scott's paper and to see how he proposed to do away with at least a part of the trouble. This is the only way out.

I have been counterbalancing locomotives for many many years. We usually counterbalanced one-third of the reciprocating parts and placed it either opposite the crank or on a slight angle similar to European practice. Then in 1904 at the locomotive testing plant during the St. Louis Exposition the soft copper wire was used to determine the blows on the rail, which of course also developed, that if this blow was greater than the weight on the driver, it would lift the driving wheel of the track in its upward path.

Unfortunately the blow on the rail is not diminished any

by a heavy load or a heavy wheel, as the wheel does not act as a shock absorber. On the contrary, the eccentric masses of the wheel cause the blow.

Regarding the introduction of the conical plate pistons, I would like to state that already in 1893 I figured and designed one such a piston in steel casting for a compound locomotive, which gave excellent results, so we are not asleep on this side of the pond.

Proportioning the percentage of pounding effect to the weight on the drivers is rather unfortunate and was undoubtedly adopted so as not to run over 100 per cent, which would mean lifting the driver. I certainly think it would be much simpler and more safe to simply allow a certain maximum blow on the rail, above which we should not go. This regardless to weight on drivers. This at once would also take care of the speed.

Regarding the question brought up by Mr. Eaton of case hardening the piston, I do not see exactly what we would gain by this as the rim is not supposed to come in contact with the cylinders at any time and as the plate would be weakened, or rather made heavier, to the amount of the material case hardened, as this material is so hard and brittle that we could not depend on it for strength. At any rate, I would like to make this meeting less harmonious than it has been.

I certainly have to congratulate Mr. Scott on the paper. I only would have liked to have him explain one picture a little more in detail, namely, how the rolls are set on an angle.

MR. SCOTT: It is rather a long mechanical story to explain in detail how the rolls are set on an angle, etc., but it may be in order to state, here, that every gentleman present is invited to visit the Homestead Steel Works and see this mill in operation. It is only necessary to arrange for a pass at the general offices before going to the steel plant.

MR. EATON: I would like to ask Mr. Scott whether it would not be feasible to case-harden the outer cylindrical surface of the piston, and then grind this surface, thus securing on the inside of the cylinder, in case the cylindrical surface of the piston and cylinder come together, the well-recognized combination of a polished case-hardened surface running on cast iron.

MR. SCOTT: Theoretically, Mr. Eaton's suggestion is good. The case hardened, ground, surface should wear well

with cast iron cylinder wall but as far as I know, this has never been tried in superheater locomotives and I would not care to recommend it tonight. In any event, case hardening would increase the cost of a steel piston from a half to a cent per pound which would be very much more apparently, than facing the piston with a good anti-friction metal capable of standing the ravages of superheated steam. The latter design has one great advantage, namely, that the rolled steel piston should last indefinitely as the anti-friction bull ring, only would need renewal. If the case hardened piston were used, it would sooner or later wear to such an extent that the entire piston would have to be scrapped.

MR. STORER: Mr. President, I simply want to announce that there will be a meeting of the American Society of Mechanical Engineers in New York next Wednesday at 2 o'clock at their Society rooms in the Engineers building, at which the "Steam Locomotive of Today" will be the topic. Discussion is to be taken part in by some of the principal locomotive designers of this country and Canada, and we expect a most interesting meeting. If any of you can possibly arrange to be in New York on Wednesday, go up there and hear the discussion at 2 P. M.

MR. A. G. MITCHELL: This paper and the discussion thereon having been of such great interest, I move that we extend to Mr. Scott a rising vote of thanks.

The motion was carried unanimously.

There being no further business,

ON MOTION, adjourned.

J. B. Anderson

Secretary.

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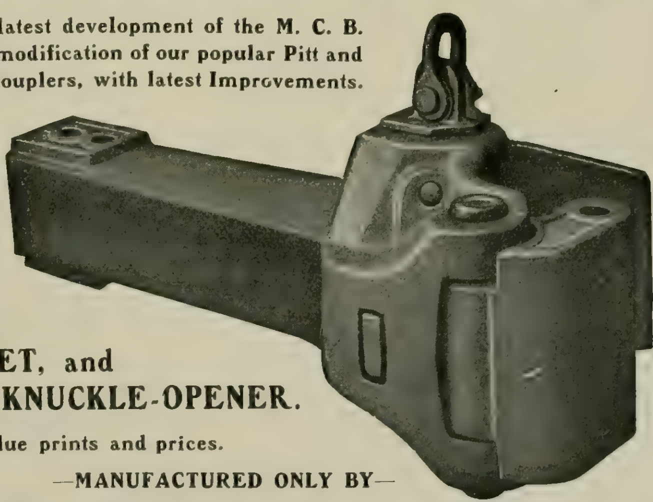

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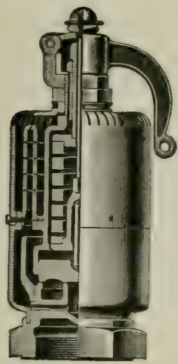
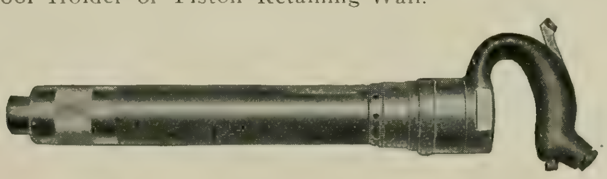
NOTES ON TRANSPORTATION IN EUROPE

By A. STUCKI





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OFFICIAL PROCEEDINGS
OF
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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING, DECEMBER 22, 1914.

The regular meeting of The Railway Club of Pittsburgh, was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock P. M., December 22, 1914, by President, F. M. McNulty.

The following gentlemen registered:

MEMBERS.

Albree, C. B.
Allison, J.
Anderson, A. E.
Anderson, J. B.
Antes, E. L.
Austin, F. S.
Barth, J. W.
Battinhouse, J.
Bihler, L. C.
Boehm, L. M.
Buffington, W. P.
Caine, C. D.
Carroll, F. E.
Cassiday, C. R.
Chittenden, A. D.
Code, J. G.
Cooner, L. D.
Cooper, F. E.
Courtney, H.
Cunningham, R. I.
Dambach, C. O.
Detwiler, U. G.
Duggan, E. J.
Easter, Dr. D. M.
Elverson, H. W.
Endsley, L. E.
Eriksson, E. S.
Evans, E.
Evans, F. J.
Felton, F. J.
Forcier, F. W.
Francis, W. S.
Fulton, A. M.
Gearhart, J. A.
Glassburn, S. G.
Greiff, J. C.
Grewe, H. F.
Gross, C. H.
Hammond, H. S.
Harriman, H. A.
Haynes, J. E.
Henderson, J. W.
Howe, H.
Howe, D. M.
Huchel, E. W.
Huchel, H. G.
Hudson, W. L.
Johnson, W. A.
Kelly, H. B.
Kinch, L. E.
Kinter, D. H.
Knickerbocker, A. C.
Knight, E. A.
Koch, F.
Krimmel, H. E.
Lansberry, W. B.
Laughner, C. L.
Lindstrom, C. A.
Lobez, P. L.
Low, J. R.
Lowry, R. N.
Lyle, D. O.
MacQuown, C.
Mahey, C. G.
Marshall, W. T.
Maxfield, H. H.
Millar, C. W.
Mitchell, A. G.
Mitchell, J. Jr.
Miyasaki, Y.
Murphy, W. J.
McCollum, G. C.
McFeatters, F. R.
McNulty, F. M.
Newell, E. W.
Painter, Jos.

Parke, F. H.
Penn, Wm.
Pfeil, John
Pie, J. J.
Porter, H. V.
Postlethwaite, C. E.
Putney, F. C.
Rea, C. S.
Richardson, L.
Runser, K. W.
Ryan, W. F.
Schaich, W. L.
Sheets, H. E.
Sleeman, W. C.
Smith, E. M.
Smoot, W. D.
Snitzer, N. E.
Snyder, F. I.
Streib, G. A.
Stucki, A.
Suckfield, G. A.
Summers, E. W.
Summers, J. M.
Thomas, J. H.
Vowinkel, F. F.
Walter, W. A.
Walther, G. C.
Watkins, G. H.
Wyke, J. W.
Yungbluth, B. J.

VISITORS.

Allen, H.
Altman, E. W.
Cope, F. B.
Davis, H. H.
Dodds, A. W.
Evans, H. E.
Floyd, H. E.
Hall, A. R.
Harvey, W. B.
Huggans, J. H.
Hultan, K. A.
King, C. C.
King, S. A. Jr.
Lundbery, F.
Marcus, M.
Marshall, W. R.
Metcalf, M. F.
Maxwell, F. R.
McDowell, A. C.
Parrish, M. D.
Pierce, C. F.
Rauterkus, J. A.
Reynolds, L. A.
Rhodes, J. E.
Simpson, I.
Seewald, J. H.
Stenson, G. A.
Stewart, W. W.
Stone, P. R.
Truitt, A. R.
Vickers, T. F.
Wolfe, L. L.

PRESIDENT: In as much as we have the attendance by registry card the roll-call will be omitted. The reading of the minutes will be dispensed with as they are now in the hands of the printer. The Secretary will please read the applications for membership.

SECRETARY: Mr. President, we have the following applications for membership:

Beggs, Chas. T., Special Agent, Aetna Life, Accident & Liability Co., Benedum & Trees Building, Pittsburgh, Pa. Recommended by H. E. Krimmel.

Caldwell, J. Oliver, Clerk, Pennsylvania Lines West, 1014 Penn-

sylvania Station, Pittsburgh, Pa. Recommended by G. A. Streib.

Clarke, C. H., Storekeeper, P. & L. E. R. R., McKees Rocks, Pa. Recommended by C. W. Alleman.

Droz, C. A., Traffic Manager, American Lumber & Manufacturing Co., 1006 Peoples Savings Bank Building, Pittsburgh, Pa. Recommended by W. J. Herman.

Dygert, Harold B., Assistant on Engineer Corps, P. C. C. & St. Louis Ry., 1013 Penn Avenue, Pittsburgh, Pa. Recommended by W. B. Dygert, Jr.

Flory, F. C., Principal, Sharpsburg Schools, 1934 Main Street, Sharpsburg, Pa. Recommended by F. L. White.

Handy, J. O., Research Director, Pittsburgh Testing Laboratory, Pittsburgh, Pa. Recommended by A. Stucki.

Harvey, W. B., Assistant Foreman, Westinghouse Air Brake Co., 277 Welsh Avenue, Wilmerding, Pa. Recommended by J. Battinhouse.

Hobson, H. A., Assistant on Engineer Corps, Pennsylvania Lines West, 625 Pennsylvania Station, Pittsburgh, Pa. Recommended by D. O. Lyle.

Ramsey, R. S., Draftsman, Pressed Steel Car Co., 200 North Avenue, Pittsburgh, Pa. Recommended by H. E. Krimmel.

Reid, John W., Draftsman, Pressed Steel Car Co., 3210 Faronia Street, Sheraden, Pittsburgh, Pa. Recommended by H. E. Krimmel.

Stamets, Wm. K., 4077 Jenkins Arcade Building, Pittsburgh, Pa. Recommended by Frank Ryman.

Vaughn, C. C., Yellow Pine Manager, American Lumber and Manufacturing Co., 1006 Peoples Savings Bank Building, Pittsburgh, Pa. Recommended by W. J. Herman.

PRESIDENT: When the Executive Committee have passed on these names the applicants will become members of the Club.

PRESIDENT: Gentlemen, there being no further business we are up to the paper of the evening, entitled "Notes on

Transportation in Europe," which will be presented by one of our faithful officers, Mr. Arnold Stucki. I take great pleasure in introducing Mr. Stucki.

MR. STUCKI: Mr. President and members of this Club, you will read on the front page of this paper an announcement which is rather promising. I want to tell you before I read the paper that I didn't make any such promises, that somebody else did this, and if there are any shortcomings, please go for them, however I will make a few remarks in regard to my personal experiences after I get through with the paper. I could write books on it, it is true, but so much has been said in the public press of late, that I am afraid to become guilty of repetition hence I have limited my remarks to a small sketch just covering four days, from August 1st to August 4th, covering a travel from one of the highest Swiss mountains until we reached an English boat at Naples.

Notes on Transportation in Europe

By A. Stucki.

The word "transportation" has been used in its broadest meaning, it is to include passenger as well as freight. The paper is not a specific study of any one thing but simply a record of spasmodic recollections from my last summers travels abroad. Statistics and other abstract details were left out. Care was also taken to avoid such adverse criticism which often results from lack of understanding the respective organization, its system and the surrounding circumstances and which often results from our habit of underestimating anything we are not used to.

I will mention, however, such details which struck me as interesting and from which we may be able to draw conclusions pertaining to our own system by comparison or otherwise.

Travel in the Air.

Starting at the top, a word on this subject may not be amiss. The various aeroplanes of course depend on motors for their sustaining power. Their carrying capacity is of necessity

very limited and heretofore the safety of the vehicle has been considered as depending entirely on the reliability of the motor. Of late this theory has become refuted and about all that is necessary for a safe descent in emergency cases is an open field in sight. The Swiss Aeronaut, Bieder, for instance, has now demonstrated this on arious occasions.

The air ship proper, on the contrary, is self-sustaining and the carrying capacity is only limited by the size of the body and its usefulness in warfare has for years been realized by the different European nations and great sums of money have been spent in view of this. In Germany Count Zeppelin has perfected it to almost an ideal state of construction and the only danger which can in times of peace befall this conveyance is an unexpected storm.

It is significant that since the early days of Zeppelin's endeavors the German government lent aid to this undertaking, and so much so, that all the ships are practically owned by the Military Department. The purpose of this is now more apparent than it was last summer. At that time I had the good fortune to be in Leipzig in the Hall while they renewed a sectional bag in "Sachsen." In this air ship there are seventeen bags. Each one of course fits the outline of the body at its certain location and is made gas tight by the use of double cotton fabrics covered with rubber.

The frame is of aluminum, mixed with a small percentage of lead, of very light construction, neatly covered with canvas, which however is not made air tight, so as to give the gas, which might escape the bags, a chance to get away. This way the danger from fire is practically avoided.

In the center underneath is the parlor, holding twenty persons. One motor in front and two in the rear of about 120 H. P. each, also hanging underneath, propel the monster, while the steering is done from the rear by rudders. There also is the captain's bridge.

The body of the ship is about 600 feet long and 60 feet in diameter, holds 700,000 cubic feet of hydrogen. The hall is built to house two such air ships at one and the same time, and although the largest portion of each end is on wheels to form the doors it is exceedingly hard and dangerous to house the ship if the cross current in the air is over 15 feet per sec-

ond. The speed is equal to that of an express train; fare 100 marks per hour for each person.

Mountain Railroads.

Switzerland, owing to its natural beauties, romantic and historical features, has become the mecca of all tourists. That country is also blessed with an abundance of water power, so that the rapid development of mountain railways was naturally to be expected.

Most of them are merely *Rack Railroads,* depending for their safety on power brakes, hand brakes and special, automatic rail grips.

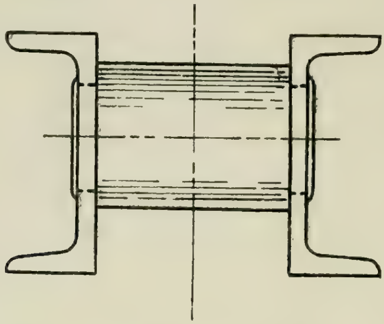
Many rope driven *Inclines* are now penetrating gorges, caves and hidden waterfalls, which were never seen before by human eyes. These inclines are really wonders judged from an engineering standpoint, not even speaking about the great scenes thereby made accessible. Here again perfect safety is obtained by the use of extra ropes and automatic rail grips. Many of these inclines are even built on curves, which shows the great obstacles often encountered in these undertakings.

The rope suspended *Gravity Incline,* driven by filling the watertank of the descending car is still resorted to, when waterfalls are near, but owing to the cumbersome way of operating and slow reversing, electricity is fast supplanting this kind of a propelling power.

There is still another kind of railroad, a Combination of *cog and adhesion,* effectively used. It enables the engineer to run by adhesion alone on the flat portions such as the valleys, while at the steep gradients he can, without stopping, engage the cogs, so that the two will work in unison, the gearing being such that the cogs take most the load. Of late these engines have been improved in such a way so that by means of intercepting valves all the gear wheels are cut out as soon as flat portions in the track are reached, whereas before, these wheels were always moving, pulling against the rack, whenever a rack was there, and simply rotating otherwise.

As an extra precaution against accidents four different kinds of brakes, hand and power, band and brake shoe are installed on these engines. Years ago they made the cog rails of cast steel, but since the disastrous failure on the Rigi, they

are all made of rolled material, using two channels back to back with holes punched in the webs and shouldered cogs inserted into place and riveted, as shown in sketch below.



Electric Railway Systems.

Fourteen years ago I found in Bern two systems used in their city and suburban traffic, namely, the pneumatic and the electric. Today the latter only prevails, as it was found the most economical, efficient and convenient system of the two. The compressing of air was found expensive and the limitation of travel with a certain given volume made special arrangements in the operation of cars necessary, while on the other hand the flexibility and the almost unlimited supply of power in the electric system was soon appreciated.

Electricity is now universally used in the underground, elevated and street service, conveyed either by trolley, conduit or third rail. The cars are either one or two stories high, as a rule of neat appearance in and out. On the elevated and subway trains the multiple control system is used, making it possible to start and stop very quickly and without jerking.

As a rule all these various methods of transportation are up-to-date in every respect, effective, convenient and well able to take care of emergency crowds. This latter item is espcially significant, since European street cars have a great many restrictions and regulations as to their operation. Notices as to seating capacity, as to number of passengers allowed inside, as to standing room on each platform, as to how to get off and on the cars, warning not to occupy certain places reserved for the conductor and many other instructions are conspicuously exhibited. As I one day had quite a long ride, I had time to read them

all and then asked the conductor how he managed to take care of large crowds, such as factroy and shop employees, theater, church and convention gatherings, and he answered me that he was to use judgment and that his duty was to transport as many as possible without however taking any risk as to their safety. This spirit pleased me very much, especially since the case happened in one of the large cities of Germany, where carrying out the "reglement" to the letter and with military precision is usually considered as selfunderstood.

Motor Omnibus.

In the metropolis of Europe the "motor bus" plays a most important part in the transportation of people. It is the successor of the horse omnibus, has the open upper story with the picturesque winding stairway at the rear end. A splendid means of seeing the streets of a city in dry weather; in inclement days it however is different, as the only protection is a knee apron to each seat. It is remarkable how effective this service is in spite of the fact that a good deal of time is lost in going upstairs and in coming down again and in spite of the fact that the number of passengers is limited to the number of seats. All these seeming drawbacks are to a large extent overcome as soon as the public gets used to this kind of vehicle. In getting off, the passengers will hold themselves in readiness below and use the platform as a temporary abode in getting on. Indeed, the motor bus is indispensible in busy streets and in places where overhead wires are not tolerated. They are likewise very useful on the macadamized roads of the suburbs and most effective in forming a flexible connection between a city and its surroundings.

There being no tracks nor power transmission, it makes the installation of this service rather inexpensive, which undoubtedly helps in introducing it. Similar omnibuses are now being used in some American cities; however, the upper story is left off.

As a rule, these two story vehicles are most picturesquely covered with advertising matter, in and out, so much so that an unacquainted traveler in hunting the name of the route, is reading advertisements long after the car has passed. This is not unlike the task of finding the name of some of our newspapers in between a mass of conspicuous printing, large letters and loud colors.

Travel in Passenger Cars.

The European passenger cars are all small and are divided into small compartments, each holding a limited number of passengers. Most of the French cars have running boards along each side and doors opening outward from the compartment. The German and Austrian cars usually have an aisle along one side of the car with a door leading from each compartment into it. The Swiss cars as a rule have center aisles with partitions between each compartment built solid to the ceiling and doors across the aisles.

In any case each compartment is independent of the other, has its own lamp which can be set at bright or dim, a ventilator with open and closed positions, a steam heat lever to regulate the heat and curtains to be drawn at night. Each compartment is also marked "Smoker" or "No Smoking," some even are reserved for passengers with dogs. Each compartment often has a small stationary mirror and hinged arm rests, so that the seats can be used as a sofa if the number of occupants so permit. On the face of it there seems nothing lacking as to the comfort of the traveler.

Strange to say, such a subdivision of the cars, however, has also disadvantages. It is almost impossible to fill the car to its seating capacity. There may be too many second class passengers and very few of the first class, or vice versa, so that seats will be left empty no matter how carefully the cars are selected. Then again there may be more smokers than expected or just the reverse; but the greatest difficulty exists in filling all the seats without splitting up the parties into different compartments and here I find lies the greatest difficulty. These points just mentioned affect the earnings of the railroad companies.

The other disadvantages affect the traveler and his comfort. Just imagine for a moment a group of strangers in one closed compartment. One likes to look at the country, the other one wishes the sun kept out; one prefers the door to the aisle open to get some air, while a lady may object to the fumes coming from the adjoining smoking compartment. One may insist in opening the ventilator, while the next one may feel chilly even with it closed. Later in the evening some may want the light turned down to dim so as to be able to sleep while someone else wants to read. For the same reason one may want the curtains

drawn and the other one may not, and in the morning the disputes may be renewed in reversed succession. During the winter season differences may come up as to the way of operating the steam heat and no matter how many rules and regulations exist, the harmony and the comfort of the traveler is bound to suffer.

The fact that in most parts of Europe no baggage is checked free is no doubt responsible for making a storeroom out of the compartment. Invariably I found the hat racks loaded with heavy baggage up to the ceiling (turtle back) and were it not for the good-natured porters, travel would be a curse. He takes more interest in his "client" than all the other railroad employees put together. He takes care of your baggage, and inquires as to the kind of compartment wanted. He opens the doors as soon as the train backs up to the station, hunts and covers the number of seats wanted, window seats if possible, and you get as a rule any information from him you require in the most pleasant way.

About from twenty to thirty minutes are usually allowed to get a train ready to start and it is my observation that all of that is needed, as each compartment has to be inspected and the number of the seats taken, registered. Besides that the closing of the doors all along the train also take a good deal of time, not only at the terminal, but also at the way stations. The Swiss center aisle cars have no doors opening outward and hence are not subject to the last mentioned objection. They are similar to our own cars in that respect.

Only the heaviest cars of comparatively recent build use trucks; by far the greatest portion use stationary axles, two or three in number. In the last case the middle axle has lateral freedom so as to accommodate the passing of curves. The cars being light and there being no springs in tandem, results naturally into a very hard riding car compared with our own. Lengthwise, however, the reverse is the case. The making up and rearrangement of trains does not require the everlasting bumping so pronounced in closing our heavy and ever increasing automatic couplers.

The trains are yet coupled with the hook and the slack is taken up by the employee going between the cars and tightening up the screws. I often wondered why in a land where the protection of employees in shops and private establishments is

made compulsory, the trainmen in coupling are allowed or rather compelled to go between the cars.

I happened to see a hospital car, which was equipped to run in all the European states except Spain and Russia, because I understand they have a different gauge. Here the arrangements at the end, not even speaking about the different brakes and signal apparatus, were so manifold that I at once appreciated doubly what the M. C. B. Association accomplished in bringing the many hundred private roads together and getting up common standards for the most important details, while the few state railroads not even could agree as yet on a common automatic coupler.

The destination of each car in Europe is indicated by a large reversible signboard fastened to the side of the car body. They are not ornamental but they are a great deal of a comfort to the traveler and I am sure that we should do the same thing. This would at least avoid the painful duty of classifying the passengers in entering a train of cars with different destinations. It would not be necessary to disfigure the appearance in any way and the signs could be applied similar to what is now being done on Pullman cars, or better yet on the subway cars of our large eastern cities.

Sleeping Cars.

With the exception of the cars owned by the International Sleeping Car Company, which run on some of the fastest express trains, the European sleeper is mainly built like their ordinary passenger car. The interior is like our compartment sleepers, namely, an aisle along one side of the car. The compartments of the second class have two berths above each other and a small table, and a small toilet at the end of the car is the only accommodation, while the first class compartments contain single berths and private toilets. All sleeping cars are owned by private companies and the berth can be engaged ahead. Sleeping cars are not provided freely with night trains, as the conventional compartment in the day car is in itself considered yet half sleeping car. In comfort and arrangement our Pullman sleeping cars are really excellent and the only criticism is that lower and upper berths are not made private from each other, and often necessitates exposures which would not be tolerated anywhere

else. This I am sure will soon be remedied, especially since it can be done in such an easy way.

Dining Cars.

The dining cars in Europe are owned by private companies. The meals are invariably served table d'hote, serving the whole car at one and the same time. This reduces the number of waiters in an astonishing way, but it deprives the traveler of individual attention and hurries him unduly as the courses follow each other very rapidly so as to get the next setting accommodated as quickly as possible. This in a sense increases the capacity of the dining cars and the earnings of the company. The meals are usually excellently cooked and cost about 75 cents nominally, $1.50 actually. In our dining cars the capacity is often reduced by not serving promptly.

Freight.

Owing to the lack of great masses of bulky freight and comparatively short hauls, the capacity of the European freight car is seldom over fifteen tons. Two axles per vehicle are the rule. Often a third one is located in the center, arranged so that it can move laterally to avoid binding on curves.

What has been said about the lack of common standards amongst the comparatively few state railway systems on passenger equipment holds good to an even greater degree on freight cars.

Relative Cost of Transportation.

Without going into great details let us consider the fare between Pittsburgh and Chicago (468 miles), taking in one case our conditions as a basis and then giving the parallel figures, using the rates of the Prussian State Railways—baggage in both cases is supposed to be 75 pounds.

A man holding a seat in a Pullman car pays $2.00 for it and $10.50 railroad fare, a total of $12.50. The baggage is checked and carried free of charge. Our German cousin traveling first class would pay a railroad fare of $15.68, for baggage $2.00, or a total of $17.68.

A traveler in our day coaches of a less expensive train

will pay $9.50. In Germany the corresponding mode of traveling would be second class, the railroad ticket being $8.92 and the baggage charges $0.50, a total of $9.42.

By far the largest portion of the European traveling public ride in third class cars. The fare is $5.55 and the baggage charges 50 cents, which means a total of $6.05. We have no parallel case for this class, hence, cannot give comparative figures.

In shipping freight, the tariffs in Europe are so specialized as to material, as to kind of train, locality and nature of the shipment (local, through or export) that a fair comparison in each particular case is well nigh impossible and it appears to be much fairer to compare the average figures. Taking again the above mentioned railroad and our group II and the officially worked up average rate per 100 ton miles of some years ago, you will find it $1.23 abroad and $.763 for the eastern states.

It must be borne in mind that the bulk of the business transacted is about the same in each case, but the haul is only half as long in Germany. This means that terminal expenses are much greater in proportion, especially since the average shipment is comparatively small, and since a large proportion of the bulky freight is shipped by water.

An additional burden to the German shipper is the charge made by the "Spediteur." As said before, the tariff schedules are so exceedingly intricate that it pays invariably to employ an expert in this line to pick the route, to comply with the regulations and to follow the shipment. All this the American railroad does for its customer without charge.

In all questions of fares and tariffs, it must be remembered that the German railroad employee earns just about half as much as our people. In other words, the money value is ordinarily just twice as great and in looking at it from that angle the figures above given look as follows:

	U. S.	Germany	
		Nominally	Actually
Passenger fare (Pgh to Chicago) 1st class	$12.50	$17.68	$35.36
Passenger fare (Pgh to Chicago) 2nd class	9.50	9.42	18.84
Passenger fare (Pgh to Chicago) 3rd class		6.05	12.10
Freight, Average rate per 100 ton miles	.763	1.23	2.46

Reasons Given in Europe for Government Ownership of Railroads.

Since most of the railroads in Europe are now owned by the respective governments, it may not be out of the way to dwell upon the reasons leading up to it.

It has been argued by the governments that it is desirable for the industrial, agricultural and commercial development of a country to control and furnish proper means of transportation. This is undoubtedly true, but figures and facts show that our private roads offer the same transportation more promptly and for much less money.

The governments also claim that the revenue derived from the railroads will help to pay for current expenses, thus lessening the taxes of the people otherwise. This is true on the face of it. None the less, the people now agree that the heavy toll exacted by the railroads comes from the masses just the same, as the cost of transportation is simply added to the price of food stuffs, clothing, fuel or whatever it may be.

Undoubtedly the main reason for acquisition of the railroads by the respective governments is a military one. This is more or less apparent from the fact that mostly railroads and aerial navigation are centralized, while elevated and street car lines, subways and typical mountain railroads are left in the hands of private and municipal corporations as a rule.

The experience in war torn Europe for the last few months is possibly the best proof of what has just been stated. Immediately as mobilization began, the trains ceased running on their schedule time to accommodate the movements of the troops, the ammunition and the other war material, and on the morning of the third day the federal railroads of Switzerland, for instance, were bodily turned over into the hands of the military department.

I often wondered whether the same results in emergency cases could not be obtained by special laws and licenses between the government and the private companies.

A very popular argument during the amalgamation period of the railroads in Switzerland was the claim that a great economy would result by doing away with unnecessary offices. This phase of the question did not work out well; on the contrary, the number now is stated to be greater than before, since

each district has a council of its own besides the federal council.

For the same reason it has now been found that more direct and more effective business methods which were promised at that time did not realize. On the contrary, it is now a rather difficult matter to settle on any changes and improvements owing to special interests each district council represents.

Results of Centralizing Railroads.

Government ownership generally speaking has helped the weak roads and avoided critical periods which we here usually overcome by receivership and reorganization.

At the same time it leaves the formerly prosperous private roads in a less remunerative position.

It is also interesting to note how complete, down to the smallest detail, the instructions in any one of these complex railway systems are worked out. Each employee or officer is expected to carry out instructions to the letter. This is the ideal and the highest duty of every one, and if carried out, will insure employment for life. That way, every employee can feel that he has done his duty and does not need to care for anything further.

This, however, will not produce improvements, reduce labor cost, bring forth fuel and labor saving devices, not even safety.

I have for instance seen a passenger, who jumped on a car just as it started, grabbed by a station employee and as he couldn't manage him alone, another uniformed co-worker ran to his assistance. They finally succeeded in pulling off the "criminal." By this time the train was moving at a fair speed and I was very much afraid that an accident might happen as soon as the "trespasser" would loose his grip. This was a center aisle car with a platform at the end.

As a contrast to such narrow conceptions of duty, let us read for instance the honor column of any one of our railroad employee's magazines and let us compare the spirit and the results.

One thing is sure, namely, that the government railroads of Europe do not keep pace with the evolution in other branches of industry and science, and this is undoubtedly one reason why American railroads are often studied by Europe, a country much older than ours.

Another great drawback in Europe is the lack of competition. As soon as a government becomes the manager of the railroads, the rivalry between the different roads ceases, which again spells stagnation to a large extent, but what is possibly more objectionable to the customer is a cold and overbearing treatment, not so seldom noticed. You have no redress, you cannot ship over the other road. By this I do not want to say that, as a rule, their railroad employee is not polite, but real courtesy and whole soul spirit of co-operation is certainly not in evidence. Is it not natural after all? Why should the roads lay special stress on anything which does not bring them special returns?

A peculiar case came to my notice showing again how very little the government railroads are really doing for their patrons. A valise through no fault of the passenger was missent and the respective railroad office phoned ahead to have it intercepted at the next station and returned. Phone call and parcel post charges were both collected before the valise was surrendered, with the explanation that the government owns telephone and parcel post systems and would object to the railroads performing such service free, as this would minimize the receipts in those other two departments.

Objections to Government Ownership in the United States.

If all the railroads in the United States would be combined into one tremendous system, it would be so unwieldy that it could not be managed in the true sense of the word, and whoever doubts this will please read the paper of Mr. W. W. Thompson, V. P. of the B. & O. R. R., presented recently before the Engineers Society of Western Pennsylvania, wherein he shows the obstacles, financial and otherwise, which had to be overcome by constant struggle and almost superhuman efforts.

Such a system could, of course, be kept going by rules and regulations, but the performance of each road would surely suffer. In reading two excellent articles on "pooling" engines in the November number of the B. R. & P. Employee's Magazine, it was brought out that a gain in engine working hours led up to this but that as far as the performance of each engine, its physical condition and its upkeep were con-

cerned, the results were far superior at the time when every engine had its own individual attention. Therefore "pooling" the railroads would surely have similar results in this respect.

Such an immense net of government roads and a still more elaborate system of operating them would in a way lend stability to the undertaking, but this also means stagnation and inability to adapt itself to new conditions as fast as they arise.

In Europe, for instance, the passenger and freight rates and their application to certain territories are hardly ever changed and the industrial conditions are expected to adapt themselves to the railroads and their policies. We over here so far have always taken the opposite view. We believe in extending the industries in those localities where natural conditions will offer the greatest inducements, then we adjust the railroad service to the new requirements.

This is undoubtedly one of the reasons why the Canadian government doesn't operate its roads, although it has built some, helped build others and heavily subsidized the rest.

Our political contests are, we all know, fought in a bitter way, simply because the existence of so many employees depends on the respective victory. Supposing we would add another million or two of such employees, would not this fight for supremacy become alarming?

All competition between the different roads, such as to improvement in comfort of passengers would relax, also as to safety, economy in operation, economy in the shops and the upkeep of the equipment.

When the Hungarian State Railways, undoubtedly for just such reasons, had large yearly deficits, they simply raised the rates, and when one of the flourishing Swiss roads, after it went into the hands of the federal system, had a similar experience, it simply reduced the number of men, number of trains, amount of track renewals, improvements along the lines and stations and besides that held back the introduction of heavier rails; in other words, it cheapened the service.

We believe in improving the service and making it most effective and by this means try to make the two ends meet.

Each individual road so far has laid great stress on carrying the passenger as comfortably as possible and the freight as cheaply as possible. Large sums, if possible, are yearly spent to try out new devices and improve the rolling stock and opera-

tions on the road, economy and safety. This led up to self clearing gondolas, automatic couplers, high capacity cars and power, low percentage of dead weight, heavy rails, low grades, doing away with unnecessary machining and finishing of car and locomotive parts, introduction of labor saving machinery, constant improvement in the brakes and signal systems and thousands of other details, and as long as the interests of the individual man and road creates such spirit, we must win.

It is true, our competition not seldom leads to gaudy advertising, expensive terminals of "marble halls, Eygptian columns and gilt stairs." Such cases, however, are few in number and are often made self-supporting, in part at least, in using them as office buildings.

Some people think if we had one immense system, that one pattern of box cars, and one pattern of any other kind of cars would suffice and we could manufacture the equipment so much cheaper. We could, but we wouldn't. The government engineers are doing things always as well as it can be done, while the railroad engineer must always be on the guard to adapt material and workmanship to the requirements, i. e., not to use expensive material if a cheaper one will do and not to finish details unless they are made more effective thereby. The same thing holds good as to inspection and it is my personal observation that material for the government here and abroad invariably costs more than that for private roads.

Again if we had established such a few standards and everybody would be at ease, who would make further improvements? Under such conditions, could our Mr. C. T. Schoen have succeeded in introducing the steel car? Would the Monongahela Connecting Road have had a chance to build 200,000 pound cars as they did, thereby encouraging others to increase the capacity above 100,000 pounds?

Unclassified Observations.

In Europe they manage to carry the passenger to destination without tagging, but if tagging is necessary here, why not do it so that the victim can also see it?

Every ticket on the continent shows its price. This is certainly a great satisfaction to the traveler and a good check

against possible mistakes at the "window." Why is this not being followed on our roads?

The Vaterland, the boat which took us east, has a boiler capacity of 90,000 horse power, but only about 65,000 was regularly developed. Is it not strange that every pound of this coal is handled by manual labor? Why is it that mechanical stokers are not resorted to? This way fuel economy and boiler capacity could be improved and labor irregularities avoided. There is sufficient space to install them, in fact, it would be a comparatively easy matter compared with the equipment of locomotives.

Some railroads on the continent run on the right hand side, just as we do, while others use the left hand track.

Gauge cocks to determine the height of water in the tanks I have seen used to advantage.

To overcome the side bearing friction on the cars equipped with trucks, oiling is sometimes resorted to. I saw cars which had a special oil cup projecting from the side of the car for this very purpose. We believe in doing away with the side bearing friction but do not believe in periodic oiling. It is too costly and too unreliable.

Personal Experience.

On August 1st at 9 A. M., a little party of five consisting of wife, daughter, two friends and myself met at Interlaken for a trip to the summit of the Jungfrau. The outlines of this most majestic of the Alpine giants was set off sharp against the dark blue sky and the morning sun touched up the massive picture by illuminating the silver peaks and icy combs and throwing fantastic shadows against the portions less exposed. It was the omen of a glorious day.

We started our journey up the valleys on the steam road and in reaching Lauterbrunnen changed to a narrow gauge electric rack railroad which took us upward on the mountains on a surface line in serpentine fashion over trestles, under culverts, through green pastures, higher and higher, as if the train were extracting itself from the world and human associations. At last we reached the Kleine Scheideck, the highest point before we entered the real mountain. Here, 7000 feet above the level of the sea, with carpets formed of Alpine flowers all

around, we stopped at the hotel for breakfast. After this we continued our journey and soon were taken inside of the mountain queen. A continuous tunnel is cut from here in solid rock and the traveler does not see the daylight except at two intermediate stations and at the top, i. e., the Joch, 12,000 feet above the level of the sea. Here also cut in rocks we found a station, post office and restaurant. From here a short walk through extending galleries will bring the traveler to the snow gate and once we had passed this, we found ourselves surrounded by eternal snow.

What an impression it left on us! The sun was bright and warm and felt so near to us. Absolute stillness prevailed. We were too high to hear the cow bells from the Alps below. No birds, no noise, no sign of human toils could be detected. The myriads of silver peaks around us resembled diamonds in the glittering sun and to our feet below was Switzerland surrounded by the four great European nations toiling away in agricultural and industrial pursuits in peaceful contest with each other to the glory of man and its creator. Alas, a few hours later we found that this was all a dream and past, as war had been declared.

Our descent was equally glorious as the journey upward, but as soon as we reached the valley we heard the terrible news of war.

The Swiss government immediately pressed the "Landsturm" into service, the regulars and the reserve to follow two days later. At this same date the railroads were also to be turned over to the Military Department and we decided at once to leave the country for fear of getting penned in. We ate once more in Interlaken, the rendezvous of all tourists and we gazed once more at the majestic figure of the Jungfrau, now mystified by the Alpine glow of the setting sun. Our friends instead of continuing their travels decided to leave for Bern, their home, that night as both their sons were subject to the country's call to arms. All banks had ceased to honor checks and to pay out metal currency of any kind, and for this reason my friends exchanged with me all gold they had in their possession. We slept at Spiez that night, not in a regular hotel. (They were already filled with soldiers), but in a private "pension" and after breakfast in the morning we walked down to the station

to wait for any Lötschberg train. This was on Sunday morning, August the 2nd, a beautiful day with the loveliest of views down on the Lake of Thun with the encircling mountains as silent guardians.

The Lötschberg Railroad is the latest thoroughfare pierced through the Alps. With 2½ per cent of maximum grade, a track of standard gauge and using current of 12,000 volts up to the transformer on the locomotives, runs passenger equipment trains at express speed and the heaviest loads of freight known on the continent.

Although no schedule was observed whatever, we caught a train destined to take us to the canton Wallis and from there to Geneva and to Paris. A locomotive in front, one at the rear and twelve cars in the middle, we certainly enjoyed our thrilling ride through valleys along the river Kander, then up the smaller mountains. Through peaceful villages and Alps, with magnificient views on glaciers and mountain peaks, all changing every moment to make room for new panoramas more glorious and enchanting than those past.

Finally we reached the Lötschberg tunnel, nine miles in length and over 4,000 feet above the sea. With unabated speed we went on through, then drifted down the southern slope until we reached the station Brieg along the river Rhone; in other words, we were now in that part of Switzerland which is most famous for its wines, its fertile soil and its most picturesque surroundings. The charm of such views will never be forgotten, although sad recollections will be interwoven with the same. Many men and women were out gathering what crops they could, not paying any heed to church bells and their solemn invitation. Their hearts, no doubt, hid graver thoughts, as father, son, or perhaps sweetheart was called to arms and not to fail the coming morning.

Our baggage, which was sent ahead some days ago to Vevey, was, thanks to my good friend, the train conductor, phoned for and brought out into readiness for us to take along without descending from the train.

Who has not heard of Lake Geneva, the jewel of all Alpine lakes? Its softness, brilliancy and splendor cannot be described. Surrounded by the finest villas, gardens and hotels, with terraced Alps and snow peaked mountains as a background, the

picture is complete. Mont Blanc itself seemed proud of such a splendor at its feet. Swift moving steam boats and gayly decorated gondolas and the quivering reflections of the mountains in the deep all helped to make this grand sight that much greater.

This lake is also dear to many for historic reasons. Here Romans and the Teutons fought together long before our Saviour was born. Here is the Chateau Chillion where Bonnivard was kept a captive and at the other end is Geneva, the home of Rousseau.

We arrived in this city at 6 P. M. and found that all the frontiers had been closed at 4 o'clock and that the only outlet from the Swiss Republic at that hour was to Italy. The depot and surrounding buildings were all guarded by the soldiers and every train brought hundreds of other travelers. None, however, could proceed. All nationalities, all tongues and every creed were represented. A kaleodoscopic mass of frightened human beings, all asking for advice, but mostly meeting bitter disappointments.

Two hours later our party was returning and en route to Milan with the intention of going from there to Genoa as soon as we could get a boat. We breathed a great deal freer as soon as we had passed the southern portals of the Simplon tunnel—we were in Italy. Six hours after that this thoroughfare was also closed.

We further found that Gibraltar was closed, that no more ships would leave the city Genoa and that an English boat, the last to leave the Mediterranean, was ready to sail the next day from Naples.

Our efforts, it was clear, had now to be renewed to get accommodations on that boat. We did succeed, although great crowds of people down in Italy, in cities near the boat, had more advantages than we. A fast express that night took us again southward and in less than half an hour after arriving, sailed for the dear old United States.

The sight of Naples' harbor, the solemn Mount Vesuvius, the outlines of the Apennines clear cut against the southern sky, and last but not the least the beautiful blue sea turned into glittering gold by the sun, this is a picture which will dwell in our sweet memories until the end.

PRESIDENT: Gentlemen, this is a very interesting sub-

ject and it is now open for discussion. Mr. Stucki has promised to answer all questions, and if some person starts the ball rolling, I think we will make it a little more interesting. Mr. L. C. Bihler, of the Carnegie Steel Co., may we hear from you?

MR. L. C. BIHLER: Mr. President and gentlemen, I don't know what to say. I don't want to get up and criticize Mr. Stucki's paper, but there is an invitation on this advance copy stating, "We all know that Mr. Stucki delights in anti-harmonious meetings, so come and help stir it up a little." I had dinner this evening with Mr. Stucki, and the other officers of the Club, and one of them dared me to say something, and another threatened, so I really don't know what to say. The paper is pretty good. I have never been on the other side. I don't know whether he is right or wrong. I did make a few notes while reading the advance copy, and Mr. Stucki promises to answer all questions, and as there is a little curiosity in my mind I will give him an opportunity to explain.

He referred to aeroplanes and Zeppelins. One of my co-workers was in Germany last summer a year ago and he told me that the price for a ride in a Zeppelin was $5.00 per hour for four hours ride, or $20.00, and instead of giving him four hours ride they gave him five hours for the $20.00. He said that was the only money he didn't begrudge. Mr. Stucki raises the price. I don't know why, possibly on account of the war. His price is 100 marks, or $25.00, for one passenger. Maybe Mr. Stucki fell into the hands of a bad chauffeur?

Another thing I notice, he referred in his paper to the bumping of cars. He didn't offer any explanation as to how expert the engineers of trains in the foreign countries are at making up trains, or how near they can come to smashing a wooden sleeper without destroying it, or how near they can come to breaking a man's neck, as they apparently sometimes seem to do at Harrisburg on the Pennsylvania, or Buffalo on the New York Central, or Fort Wayne on the Pennsylvania Lines West,—without actually doing it. I think it would be interesting to know, for the "pay passengers" at least. The American engineers who are apparently always before arbitration boards asking for more money, than the industrial traffic manager thinks he is entitled to (but don't get)—our lives are in their hands—we admit our lives are in their hands—I would

like to know how expert they are comparatively. You have heard of the man who puts an open-face watch under a steam-hammer and says he can break the crystal without breaking the watch. Some careless engineers are trying out something like that occasionally, seeing how near they can come to killing you and yet not do it.

There is another thing Mr. Stucki touched on very gingerly, and only mentioned once—steel cars—and I thought he might have said a little more about it. I am not talking for myself; I am talking for Messrs Postlethwaite and Lindstrom to give them a chance to say something about steel cars. We have organized a foreign industrial commission and when Mr. Flannery returns from Europe we ought to hear something very interesting along this line.

With regard to the motor busses on Fifth Avenue, New York, you can see motor busses with a second story, running from the lower part of New York to Grant's Tomb. So we do have them in New York.

MR. A. G. MITCHELL: Mr. President, I am in the same box as some others here. I have never been over on the other side. I know nothing about foreign railroads from actual experience. But I have been very much pleased to notice that our good friend, the author of this paper, agrees that the American railroads are far ahead of the foreign railroads. I am always willing to take my hat off to the other fellow who says we have got the best road.

The point made by the former speaker, in the way of a little slap at the railroads, I think ought to be answered, in that only a short time ago I saw a statement made by some insurance expert that there were more persons hurt by falling out of windows than as passengers on railroad trains. So I think the remark on broken necks and so on can be minimized a little.

I have wondered too how it occurs that so soon after the publication of this advance copy of Mr. Stucki's paper the Interstate Commerce Commission should have passed the advance in rates (Laughter). The argument of the author of this paper has evidently had a wonderful effect, and I, as one of the railroad officials who hope that the railroads may be benefited

thereby, with increased business in the future, feel very grateful to him for what he has done.

MR. CHAS. F. PIERCE: I haven't anything to say on this subject, but a little squib here in the Telegram of New York may be interesting to Mr. Stucki.

Oh, London is a man's town, there's power in the air;
And Paris is a woman's town, with flowers in her hair;
And it's sweet to dream in Venice, and it's great to study Rome;
But when it comes to living, there is no place like home.

I know that Europe's wonderful, yet something seems to lack;
The past is too much with her, and the people looking back.
But the glory of the present is to make the future free—
We love our land for what she is and what she is to be.

Oh, it's home again, and home again, America for me!
I want a ship that's westward bound to plough the rolling sea,
To the blessed Land of Room Enough beyond the ocean bars,
Where the air is full of sunlight and the flag is full of stars.

MR. C. S. REA: I have read a copy of Mr. Stucki's paper and while I knew that he was a well known engineer, I never knew that he was an author of poetry. The sketch of his personal experiences is certainly a work of art, and while the paper invites criticism, I fail to know how to present any.

In regard to those bumps that Mr. Bihler spoke about having received on the Pennsylvania Railroad at Harrisburg, I might suggest that if they want to eliminate those bumps they should equip their cars with "Stucki Roller Side Bearings."

PRESIDENT: I notice Prof. Endsley is in the room. We would like to hear from him.

PROF. L. E. ENDSLEY: I am very glad to have heard Mr. Stucki's paper. I had a few impressions myself while over on the other side of the water. One thing that impressed me that Mr. Stucki did not tell, was the small locomotives that took us around. I felt when I was over there I could have hitched a Ford onto some of their locomotives and backed them up. These small locomotives are possible because of the small cars

in use. These light cars ride very well because the road bed is kept up very well especially in some parts. I rather doubt if their road bed would stand up under our heavy equipment, but for their purpose it works very well. With their light cars it is a good deal like the Ford automobile—it goes very well over a good level road but when you go over the cobble-stones, it does not ride so well.

Mr. Stucki getting out of that country reminds me of a little squib that Abe Martin said the other day: Tom Brown said, "I would like to be over there" and Phillip Lippincutt said, "I wouldn't want to be very close." I think Mr. Stucki was getting out of there as fast as he could.

PRESIDENT: I notice we have with us tonight Mr. J. W. Henderson, Chief of the Bureau of Smoke Regulation, City of Pittsburgh, may we hear from him?

MR. J. W. HENDERSON: I did not hear the first part of Mr. Stucki's paper, but I heard a little story about one of those incline roads. It is about a little engine which was working to beat the band, puffing and pulling, and they were making about one inch at a time. When they finally got to the top the engineer said, "Well we got there all right." The brakeman said, "Yes, I know, but if I hadn't put the brakes on we would have slipped back."

I don't know what is the matter with Mr. Stucki. He knows me pretty well, and offered me congratulations on this job I got into. He has not said anything about smoke in Europe, I suppose the locomotives over there are large enough to smoke. I would like to hear from him in regard to it.

PRESIDENT: Are there any others who care to take part in this discussion? If so we would like to hear from them.

MR. C. B. ALBREE: Mr. President, there are one or two points about European railways that in my experience over there, struck me as being quite well worth adopting. One of them is the system they have of landing at big terminals.

At London, Edinboro, Glasgow, or any other big city, you will find that instead of requiring you to give up your railroad ticket when you leave your station, as they do at the smaller stations, over there, the guard comes up and takes your ticket. The result is when you get to the terminal you are free to leave

the carriage. Then you find a platform and cabs on the other side of the platform. You put up your finger and the cabman comes to you instantly, and you go right to the luggage vans and you point out your trunk; they are thrown out of the vans immediately. You have no check, simply registered, and every man is supposed to know his own trunk. You get your own when you see it, and you point it out to the cabby, and within two or three minutes after you get out of that train you get into your cab and you have your trunk on it and you go to a hotel. In the United States you give your checks to Transfer Agent and do not get the baggage for hours.

PRESIDENT: Can we hear from any of the others? If not, we will ask Mr. Stucki to close.

MR. STUCKI: I must agree with Mr. Bihler in a good many respects. I was bumped often, and I know that improvements are possible there. The remarks about foreign trade are really appropriate, but I heard more about that in this country than over there, as the minds were too excited and wholly absorbed by the war. He is right when he says, that two-story motor cars are operated on Fifth Avenue in New York. I did not think about them, when I made the remark. But what pleased me more tonight than anything else is the fact that Mr. Mitchell attributes the 5 per cent increase in freight rates to this paper.

Mr. Pierce's poem awakened vividly the feelings I had, when we chased around to extricate ourselves from the meshes thrown around us by the warring nations. It looks more like a joke just now, but didn't then.

To Mr. Henderson, I may say that I didn't see any smoke over there, possibly because coal and briquets cost much more than over here, hence it pays them to burn it up completely, not even speaking of the annoyance caused by smoke aside.

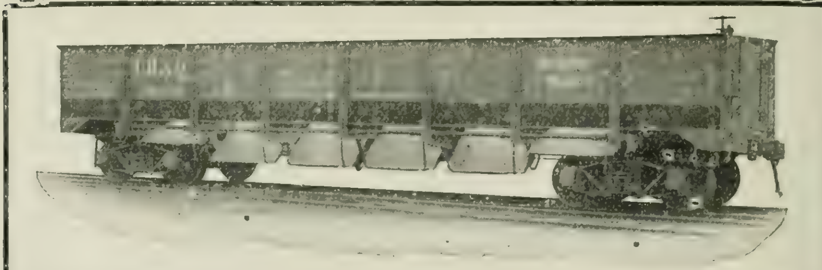
I have nothing else to add except that Mr. Albree's remarks are right to the point, but the speed he talks about is the result of competition between the different cabmen and the desire to enhence the tip. This proves again, that competition is absolutely necessary to stimulate the efforts.

Before closing I want to thank you gentlemen for the great patience you have shown in listening to this paper.

MR. J. G. CODE: Mr. President, I move that a rising vote of thanks of the Club be extended to Mr. Stucki for his very interesting description of the railroad facilities in Europe, and his very poetic description of the Alpine scenery.

ADJOURNED.

J. B. Anderson
Secretary.



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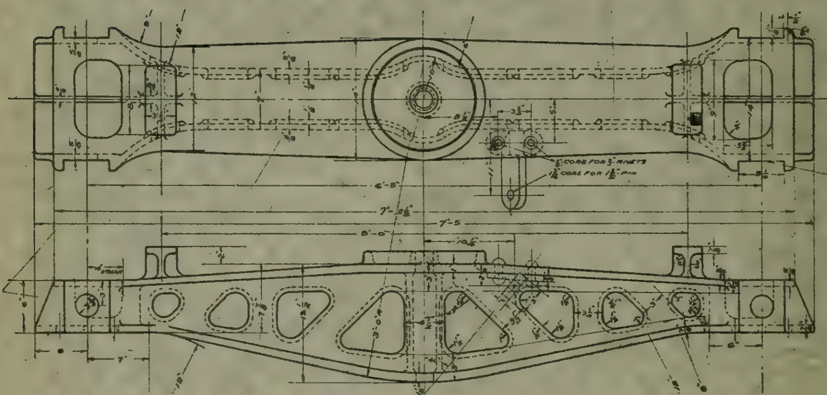

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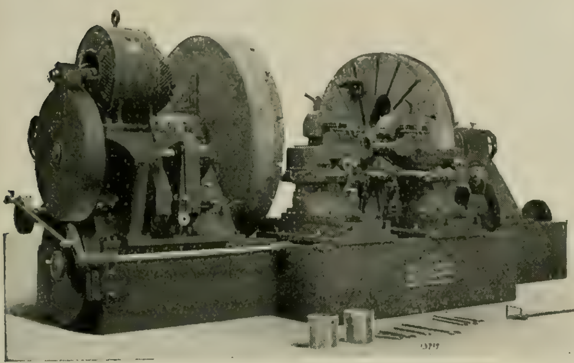

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OFFICIAL PROCEEDINGS
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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING, JANUARY 22, 1915.

The regular monthly meeting was called to order at the Monongahela House at 8 o'clock, P. M. by President F. M. McNulty.

The fololwing gentlemen registered:

MEMBERS.

Anderson, A. E.
Anderson, J. B.
Austin, F. S.
Babcock, F. H.
Barth, J. W.
Battinhouse, J.
Brewer, W. A.
Brosemann, W.
Boehm, L. M.
Bohannon, G. L.
Bond, W. W.
Buechner, W. A.
Buffington, W. P.
Burket, C. W.
Byron, A. W.
Caine, C. D.
Caldwell, J. O.
Carroll, F. E.
Cartwright, W. E.
Chapman, B. D.
Chester, C. J.
Chilcoat, H. E.
Clark, C. C.
Code, J. G.
Cook, C. C.
Cooper, F. E.
Cooper, J. H.
Cotton, A. C.
Cunningham, R. I.
Duggan, E. J.
Dygert, H. B.
Emery, E.
Endsley, L. E.
Fogle, Emmett
Fulton, A. M.
Gowdy, H. E.
Greiff, J. C.
Hammond, H. S.
Harvey, W. B.
Haynes, J. E.
Hershey, J. E.
Hoffman, C. T.
Holt, Jas.
Howe, D. M.
Howe, H.
Huchel, H. G.
Huff, G. F. Jr.
James, R. E.
Jameson, A. A.
Kinch, L. E.
Kinter, D. H.
Knickerbocker, A. C.
Knox, W. J.
Lanahan, J. S.
Lansberry, W. B.
Laughlin, C. W.
Laylin, M. H.
Lehr, H. W.
Lobez, P. L.
Low, J. R.
Mackert, A. A.
Marshall, W. T.
Maxfield, H. H.
Mellon, W. B.
McAbee, W. S.
McCollum, G. C.
McFarland, H. L.
McKinstry, C. H.
McNulty, F. M.
Neel, T. M.
Painter, Jos.
Page, A. Jr.
Parke, F. H.
Patterson, J. E.
Perry, W. E.
Pennington, F. W.

Pfeil, John
Phillips, Lee
Phillis, W. A.
Pie, Jos. J.
Pratt, I. D.
Rabold, W. E.
Ramsey, R. S.
Redding, D. J.
Reid, John W.
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Richardson, W. P.
Richardson, L.
Ritts, W. H.
Robbins, F. S.
Roemer, M.
Roemer, W.
Rowand, T. A.
Sarver, G. E.
Schaff, A. J.
Schaefer, F.
Schaich, W. L.
Seewald, J. H.
Shourek, T. L.
Sleeman, W. C.
Smoot, W. D.
Snyder, F. I.
Snyder, J. R.
Stark, F. H.
Streib, G. A.
Stucki, A.
Thomas, J. H.
Travis, J. H.
Vowinkel, F. F.
Wahlert, H. A.
Wardale, N. H.
Warne, J. C.
Warner, E. O.
Watkins, G. H.
Williamson, J. A.
Wood, H. L.
Woods, F. F.
Wyke, J. W.

VISITORS.

Andrews, J. P.
Baird, J. H.
Barclay, E. E.
Boyce, W. S.
Burson, H. A.
Coombe, A. B.
Donehoo, E. M.
Grosswege, J. B.
Haines, E. K.
Haisch, A. M.
Hane, J. A.
Herr, H. T.
Hermanson, Theo. H.
Heuthorn, J. T.
Karger, R. F.
King, S. A. Jr.
Lidstone, F. J.
Maier, J. L.
Marcus, M.
Mitchell, R. S.
McDonnell, J. R.
Neissen, E.
Pie, G. D.
Rauterkus, J. A.
Redding, R.
Reynolds, D. E.
Ryde, H. H.
Saunders, L. D.
Shepard, V. J.
Sneck, H.
Steib, W. P.
Stenson, G. A.
Stouch, E. E.
Strickler, T. W.
Tracey, E. J.
Welter, S. A.
Wolf, F. A.
Yawman, C. A.
Yost, G. K.

PRESIDENT: The roll call will be dispensed with, as we have a record of the attendance by registration card.

The minutes of the last meeting are in the mail, therefore the reading of them will be dispensed with.

The Secretary read the following list of applications for membership:

Baird, J. H., Clerk, Atlantic Refining Co., 424-426 Sixth Ave., Pittsburgh, Pa. Recommended by J. O. Caldwell.

Barclay, E. E., Locomotive Engineer, Montour R. R., 1410 Fourth Avenue, Coraopolis, Pa. Recommended by J. E. Patterson.

Burwell, L. T., Sales Agent, M. W. Supply Co., Real Estate Trust Building, Philadelphia, Pa. Recommended by C. O. Dambach.

Crawford, C. B., Gang Leader, Penna. R. R., 475 Second Street, Pitcairn, Pa. Recommended by C. T. Hoffman.

Farquhar, L. C., Representative Allegheny Steel Company, 236 Semple Street, Pittsburgh, Pa. Recommended by L. E. Endsley.

Haines, E. K., Head of Blue Print Department, Pressed Steel Car Co., 102 Owen Street, McKees Rocks, Pa. Recommended by Harry Howe.

Henry, John K., Salesman, Laughlin-Barney Machinery Co., Union Bank Building, Pittsburgh, Pa. Recommended by Harry Barney.

Lidstone, Frederick J., Time-keeper, Engineering Department, Pressed Steel Car Co., Box 184, Mt. Lebanon, Pa. Recommended by Harry Howe.

Mask, H. K., Representative Nathan Manufacturing Co., 101 Park Avenue, New York, N. Y. Recommended by J. C. Currie.

Maier, John L., Gang Foreman Blacksmiths, Penna. Lines West, 2645 Leland Avenue, N. S., Pittsburgh, Pa. Recommended by Gilbert E. Sarver.

Pierce, Chas. F., Representative Q. & C. Co., 90 West Street, New York, N. Y. Recommended by J. B. Anderson.

Richards, N. W., Traveling Freight Agent, P. & R. R. R., Oliver

Building, Pittsburgh, Pa. Recommended by C. O. Dambach.

Reynolds, T. A., Foreman, The McConway & Torley Co., 22 Fountain Avenue, Crafton, Pa. Recommended by Wm. McConway, Jr.

Ross, R. J., Salesman, Westinghouse Electric & Manufacturing Co., 1115 North American Building, Philadelphia, Pa. Recommended by J. B. Anderson.

Schroedel, A. H., Air Brake Repairman, P. R. R., 3503 Melwood Avenue, Pittsburgh, Pa. Recommended by W. H. Sullivan.

Shanahan, E. J., Clerk, The McConway & Torley Co., 48th Street. & A. V. Ry., Pittsburgh, Pa. Recommended by Wm. McConway, Jr.

Seewald, Jos. H., Clerk, Pressed Steel Car Co., Engineering Department, McKees Rocks, Pa. Recommended by H. G. Huchel.

Wagner, G. R., Engine Repairman, Spang, Chalfant & Co., Pine Street, Etna, Pa. Recommended by W. H. Ritts.

PRESIDENT: As soon as these applicants have been favorably passed upon by the Executive Committee the gentlemen will become members.

The Secretary announced the death of Mr. D. H. Haslett, Assistant Shop Clerk, Pennsylvania Railroad, whereupon the President directed that an appropriate memorial minute be inserted in the next issue of the official proceedings.

MR. F. H. STARK: May I at this time beg your indulgence for a minute or two. Mr. A. Stucki, our well and favorably known member was recently honored by being elected President of the Engineers' Society of Western Pennsylvania. The organization, as well as Mr. Stucki, are to be congratulated. Mr. Stucki is one of our most efficient and congenial officers and we rejoice over his merited recognition.

MR. A. STUCKI: I am agreeably surprised by the kind words of Mr. Stark. It is true, I consider it an honor to be president of said organization, especially since it is by far the most active local engineering society in the land, but there is

absolutely no credit due me for this. However, I deeply appreciate the kind interest again shown me by the fellow members of this club.

PRESIDENT: There being no further business, I take pleasure in now introducing Mr. H. T. Herr, Vice President and General Manager of The Westinghouse Machine Company, who has consented to address us on the subject of "Recent Developments in Steam Engineering, more especially turbines for driving electric generators and as used for marine propulsion."

MR. H. T. HERR: Mr. President and Members of The Railway Club of Pittsburgh:—I am very pleased to be with you tonight and hope that I may be able to interest you somewhat in this subject.

RECENT DEVELOPMENTS IN STEAM ENGINEERING MORE ESPECIALLY TURBINES FOR DRIVING ELECTRIC GENERATORS AND AS USED FOR MARINE PROPULSION

By Mr. H. T. Herr, Vice President and General Manager The Westinghouse Machine Company.

The purpose of this paper is to give such fundamental principles and information on recent developments in the turbine art as are consistent with the space permissible, with the hope that those interested in the subject and associated with the development of power from steam may become better acquainted with the points which are important for reliable operation and economy and better informed on the main facts relating to the development of the steam turbine and its more recent application and performance in practice.

Elementary Principles.

Like the steam and gas engine, the turbine is a machine for obtaining mechanical work from heat energy. The turbine converts the heat energy of a gas into useful mechanical work

by transforming such heat energy into velocity and then extracting the energy in such velocity by means of the rotation of a spindle, caused by the impulse and reaction of jets of steam on suitably-designed blades or vanes.

All commercial types of turbines—steam, water or gas—are divided into two general classes, viz., (1) impulse and (2) reaction. Strictly speaking, all steam turbines use both impulse and reaction in their operation.

Fig. 1 illustrates a nozzle and blade wheel in which the blades have a single curvature, i. e., the steam in its passage through the blades is not turned back on itself. If this wheel were held stationary the steam would leave the blades in a direction nearly parallel to the shaft. The only force, therefore, effective for moving the blades is the impulse of the jet.

Fig. 2 indicates a blade wheel and nozzle in which steam from the nozzle enters the blades in a direction parallel to the axis, the jet then being turned backward through an angle less than 90 degrees. On leaving the blades the jet exerts a reaction on the wheel, which, if held stationary, would be felt as a force tending to turn it.

Fig. 3 shows blades with nearly 180 degrees curvature, which turn the steam back on itself on leaving the blades. The

Fig. 1.

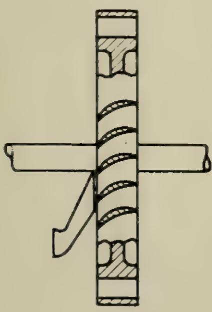


Fig. 2.

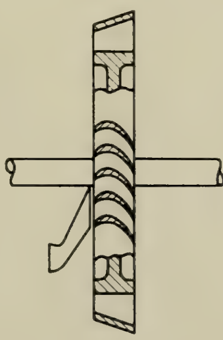
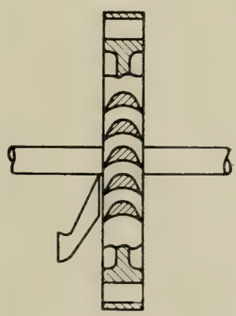


Fig. 3.



wheel would therefore be moved first by the impulse of the jet, and then by its reaction.

When steam expands through an orifice or passage it acquires a velocity proportional to the drop in pressure which it undergoes.

In the so-called impulse turbines this expansion takes place in a fixed nozzle, and the energy of the steam, due to its velocity, is absorbed in the revolving blades of a wheel without drop in pressure through the blades themselves.

In the reaction turbine the expansion of steam takes place in the blades themselves, and the velocity of the steam caused by such expansion is converted into useful work by its reaction in leaving the blades.

The way in which the blades are constructed and applied, distinguishes the different types of turbines. It may be said that all impulse machines depend on the absorption of the steam velocity, due to a drop in pressure, through suitable nozzles, there being little or no pressure drop through the blades themselves; while the reaction turbine utilizes the velocity of steam, caused by a drop in pressure through the blades themselves, to rotate the turbine spindle.

The function of a steam nozzle is the production of the desired velocity, while that of its corresponding blade or blades is to absorb this velocity for the production of useful work. Here the pressure drop is almost entirely confined within the nozzle and is non-appreciable through the blades.

On the other hand, in the reaction turbine there are no nozzles, the blades corresponding thereto. In the expansion within the blades a reactive thrust is produced in the opposite direction from the issuing steam jet, which thrust forms the major part of the turning moment of the reaction turbine, and hence its classification as such. The remainder, which is but a small factor, is produced by impulse action of steam from the various stationary rows of blades.

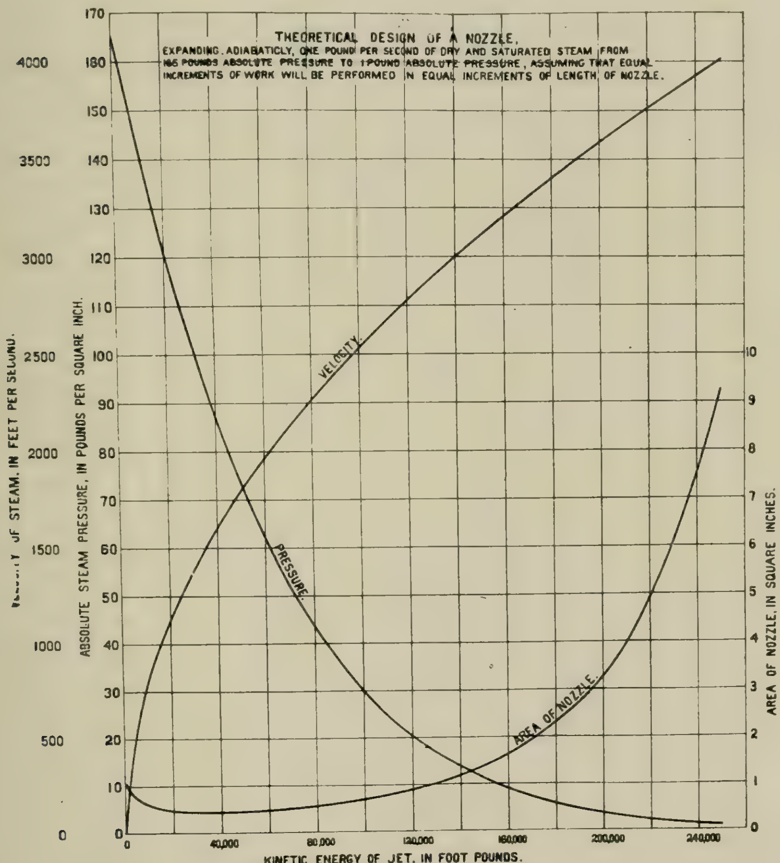
A definite relation must exist between steam velocity and blade velocity for the production of maximum efficiency.

Theorectically, in the pure impulse system the moving blades must recede at one-half the velocity of the impinging jet for maximum efficiency. In the pure reaction turbine the moving blades must recede at the same velocity as that of the steam jet in order to absorb all the velocity therein. This would appear to constitute a point in favor of the impulse system. In the reaction system the apparent objection is overcome by the simple expedient of employing more expansion stages. All

this presupposes a tangential direction of the steam jet parallel to the plane of rotation.

With side jets, such as are of necessity used in practice, it is impossible to obtain a complete reversal of the jet, and hence a part of the jet velocity is unavailable.

Fig. 4.



It is a general impression that the 1 to 1 velocity ratio must hold in reaction turbines. This is not the case, for, as has been said, the reaction system not only contains impulse principles but also uses side jets, so that the relative blade and jet speed, for the best efficiency, must fall somewhere between .5 and 1.0.

The multi-stage, (Rateau) impulse system was developed to overcome the chief difficulty of the simple impulse element, viz., the efficient utilization of the enormous steam speeds resulting from a single expansion over wide ranges of pressure.

Fig. 4 plots the velocity resulting from the expansion of steam from a pressure of 165 pounds to 1 pound absolute in a nozzle designed for uniform work. Thus a steam speed of over 4000 feet per second is obtained for the full expansion to 28 inches of vacuum. This would theorectically require a speed of 7640 revolutions per minute for an impulse wheel 5 feet in diameter—a mechanical impracticability—but by subdividing the expansion into a number of stages the velocities per stage can be reduced to practical limits. This involves the familiar multi-cellular construction used in the Rateau turbine.

In the subdivided multi-stage (Curtis) impulse system a modification of the foregoing may be secured, viz., blade speeds two or three times lower than the jet speed may be used. This is accomplished by two or more impulse wheels per stage, each absorbing its share of the total velocity delivered by the nozzles.

The energy of a jet of steam of velocity V is $\frac{V^2}{2g}$, and the velocity of the steam with a suitably designed nozzle is dependent on the drop in pressure through such a nozzle.

It is customary to diagram by vectors the action of a steam jet through the various stages of a turbine, making certain allowances, established by practical experimentation, for losses due to the physical properties of steam and the construction of the turbine elements.

In Figs. 5 to 11 inclusive such velocity diagrams are illustrated for the four types of turbines, viz., De Laval, Rateau, Curtis, and Parsons, together with diagrams of the blading of each type. The curves in the diagrams illustrate the action of the steam as regards pressure and velocity through the different stages.

Such velocity diagrams comprehend the absolute and relative velocities of the steam jets and blades, the absolute velocities being recorded with reference to the earth, and the relative velocities with reference to the blades and steam jets.

Fig. 5.

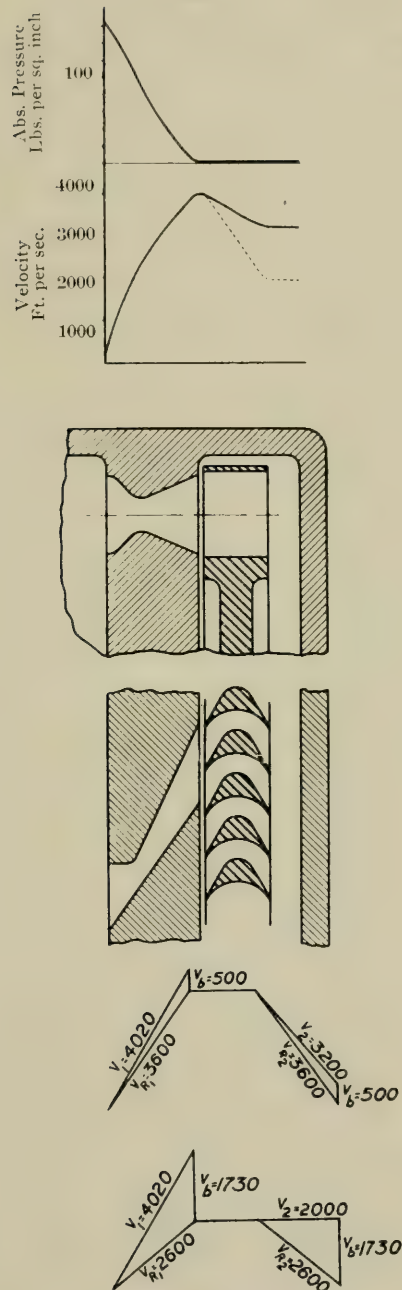
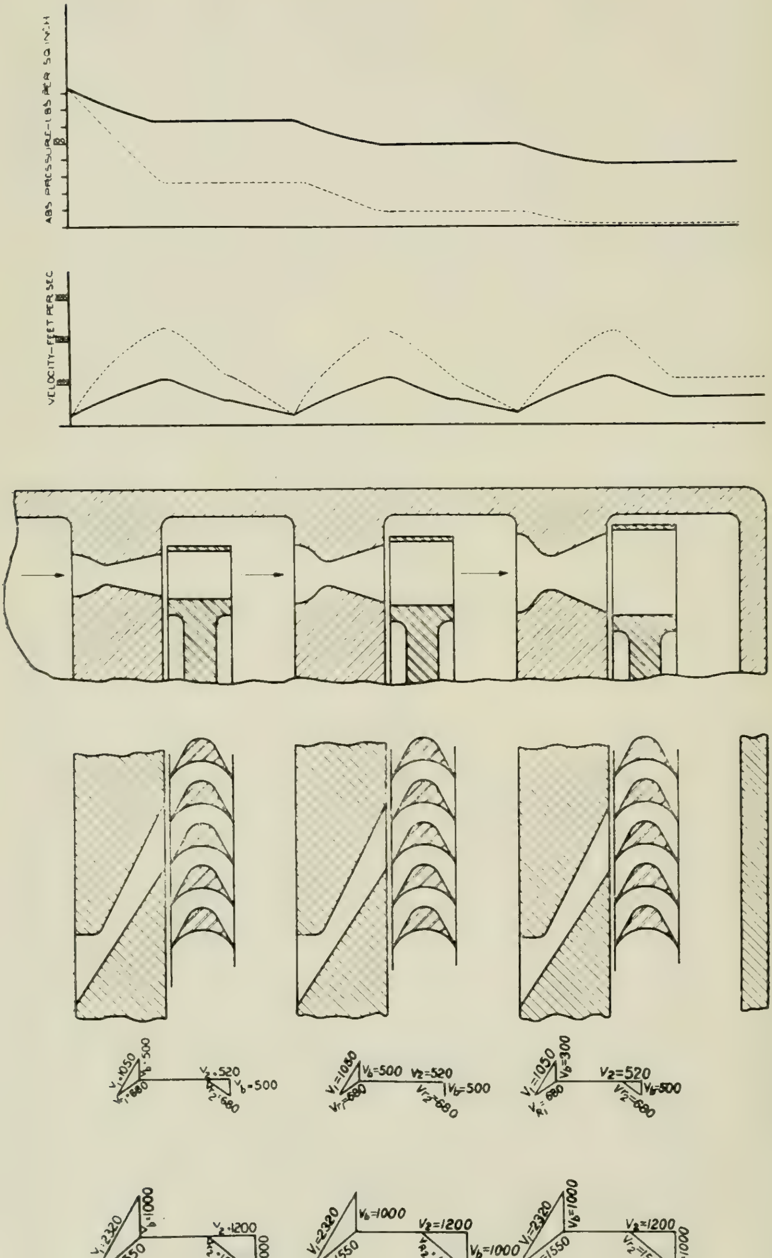

Abs. Pressure
Lbs. per sq. inch
100
4000
3000
2000
1000
Velocity
Ft. per sec.
V_b=500
V_1=4020
V_{R_1}=3600
V_2=3200
V_{R_2}=3600
V_b=500
V_b=1730
V_1=4020
V_{R_1}=2600
V_2=2000
V_b=1730
V_{R_2}=2600

Fig. 6.



ABS PRESSURE-LBS PER SQ INCH
VELOCITY-FEET PER SEC
V₁=1050
Vb=500
V2=520
Vb=500
V2=680
V1=1050
Vb=500
V2=520
Vb=500
Vr2=680
V1=1050
Vb=300
V2=520
Vb=500
Vr2=680
V1=2320
Vb=1000
V2=1200
Vb=1000
V1=2320
Vb=1000
V2=1200
VR2=1550
Vb=1000
VR1=1550
V1=2320
Vb=1000
V2=1200
Vr2=1550
Vb=1000
Vr1=1550

In the diagrams (Figs. 5 to 11) the turbine rotors of the different types are taken with blade speeds of 500 feet per second and an expansion of the steam from 165 pounds absolute to 1 pound absolute.

In the diagram of the De Laval turbine (Fig. 5) it will be seen that the jet of steam has a residual or leaving velocity after passing the wheel of 3200 feet per second, which results in a failure to abstract the full energy of the jet proportional to the square of such residual velocity. In order that one row of impulse blades such as obtain in this example might extract the maximum energy from the expansion of the steam from 165 pounds to 1 pound absolute, it would be necessary to have a blade speed of 1730 feet per second.

In the Rateau machine (Fig. 6) the residual velocity is 2880 feet per second, representing an amount of energy unabstracted by the turbine proportional to the square of this residual velocity.

If additional stages were added, this residual velocity could be abstracted without change in the blade speed, or the number of stages could be kept the same by increasing the blade speed to 1000 feet per second.

In the Curtis turbine, by subdividing the impulse elements into two, three, or four rows of moving blades per stage the same jet velocity may be used with a blade speed of 500 feet per second, with leaving losses as shown in the diagrams Figs. 7 to 9 inclusive.

It will be noted, however, that in the four-division stage extreme velocities are encountered, as in the De Laval wheel.

These high steam velocities are, as in the Rateau turbine, materially reduced by diminishing the stage division and increasing the number of stages (Fig. 10). This system presents probably the best development of the subdivided multiple-stage impulse turbine; but for a complete machine there are difficulties to contend with in the maintenance of proper steam distribution through the latter stages.

Considering, however, the first stage, of two subdivisions by itself, the advantage of this type of element is apparent. Comparing, for instance, the first stage expansion with that of a similar expansion arrangement in a Rateau turbine, it can be shown that four individual Rateau stages are required to do the

Fig. 7.

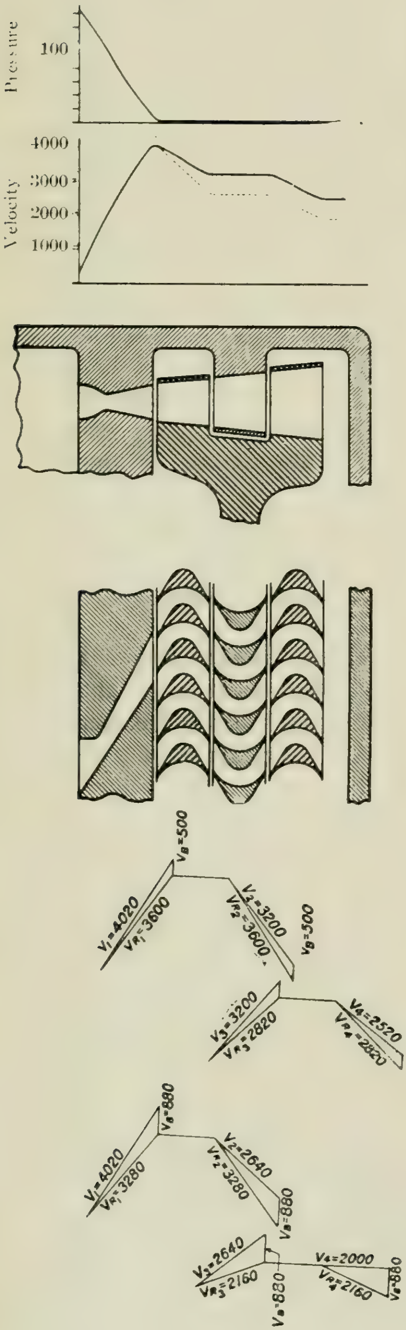

Pressure
100
Velocity
4000
3000
2000
1000
VB=500
V1=4020
VR1=3600
V2=3200
VR2=3600
VB=500
V3=3200
VR3=2820
V4=2520
VR4=2820
VB=880
V1=4020
VR1=3280
V2=2640
VR2=3280
VB=880
V3=2640
VR3=2160
VB=880
V4=2000
VR4=2160
VB=880

Fig. 8.

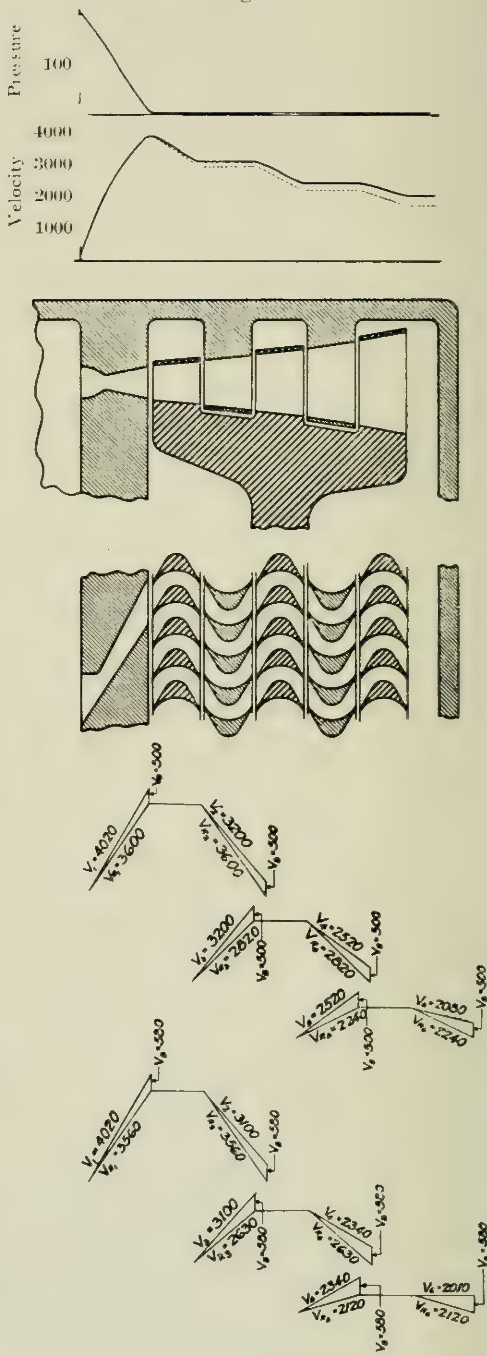
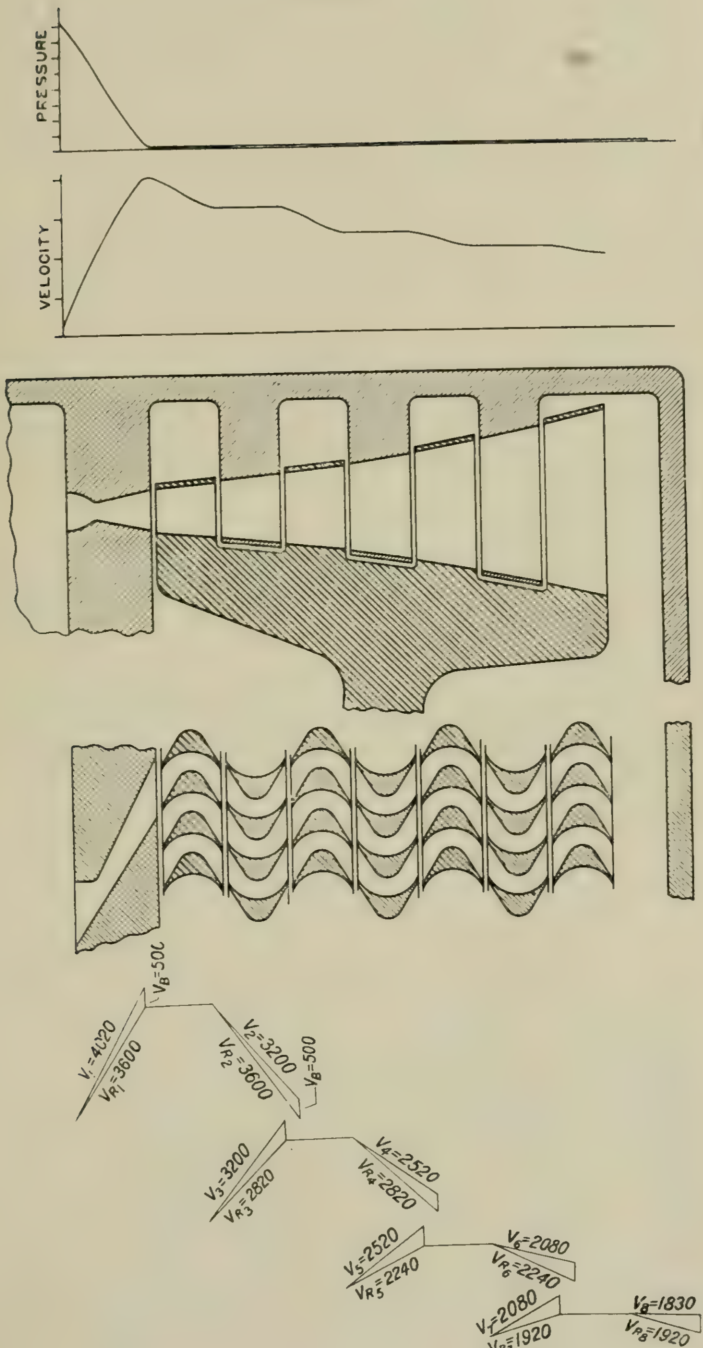

Pressure
100
Velocity
4000
3000
2000
1000
VB=500
V1=4020
VR1=3600
V2=3200
VR2=3600
VB=500
V3=3200
VR3=2820
VB=500
V4=2520
VR4=2820
VB=500
V5=2520
VR5=2240
VB=500
V6=2030
VR6=2240
VB=500
VB=580
V1=4020
VR1=3560
V2=3100
VR2=3560
VB=580
V3=3100
VR3=2630
VB=580
V4=2340
VR4=2630
VB=580
V5=2340
VR5=2120
VB=580
V6=2010
VR6=2120
VB=580

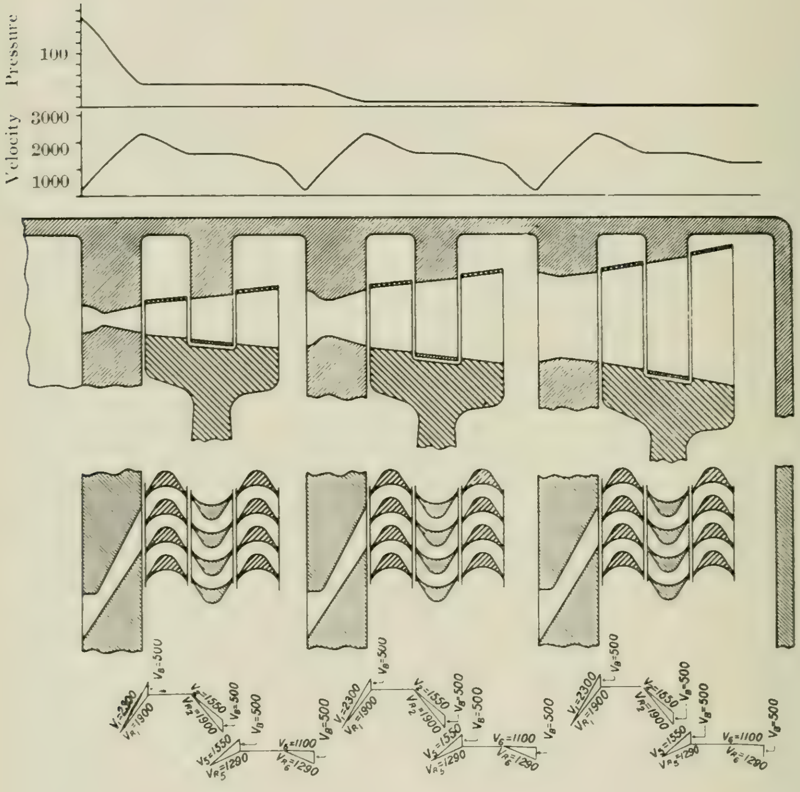
Fig. 9.


PRESSURE
VELOCITY
V_B=500
V_1=4020
V_{R1}=3600
V_2=3200
V_{R2}=3600
V_B=500
V_3=3200
V_{R3}=2820
V_4=2520
V_{R4}=2820
V_5=2520
V_{R5}=2240
V_6=2080
V_{R6}=2240
V_7=2080
V_{R7}=1920
V_8=1830
V_{R8}=1920

same work as this single subdivided two-row stage (assuming, of course, the same blade speed, viz., 500 feet a second, and the same pressure drop, 165 to 50 pounds absolute).

In the Parsons turbine the process of subdividing the steam

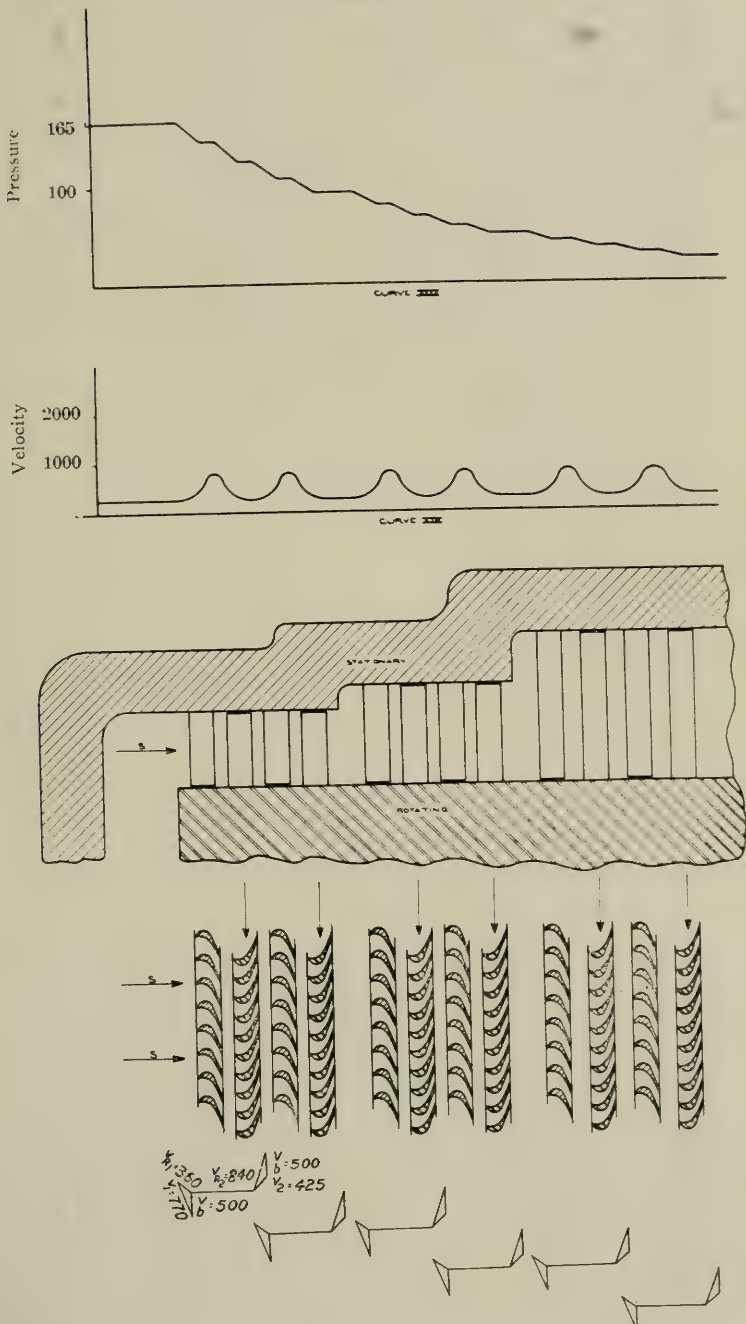
Fig. 10.



expansion (as illustrated in Fig. 11) resolves itself into a relatively large number of rows of blades. An important result secured by this subdivision is the uniformly low steam velocities through the turbine. When velocities of 1000 to 2000 feet per second are encountered throughout the Rateau and Curtis turbines the corresponding velocities in the Parsons machine will vary from 150 to 1000 feet per second.

As friction losses are a function of velocity, this relatively

Fig. 11.


Pressure
165
100
Velocity
2000
1000
STATIONARY
ROTATING
S
S
S
V2:425

low velocity is an important point, and probably to a large degree accounts for the high efficiency of this system.

It is evident from the foregoing that the application of a turbine design to commercial use must embody a knowledge of the properties of steam and its co-relation to the mechanical structure of the machine.

While the pressure-volume diagram is important in the design of piston engines, it has little use, except by comparison, in the determination of the action of steam in the turbine.

The entropy-temperature diagram and the conversion of pressure to velocity under adiabatic expansion, together with the co-relation of heat drops, form the basis of turbine calculations.

The development of the turbine has therefore led to a closer study of the properties of steam, and by experimental work and mathematical deduction the physical properties of both saturated, wet and superheated steam have now been determined with certainty and precision, so that computations based on these show satisfactory concordance.

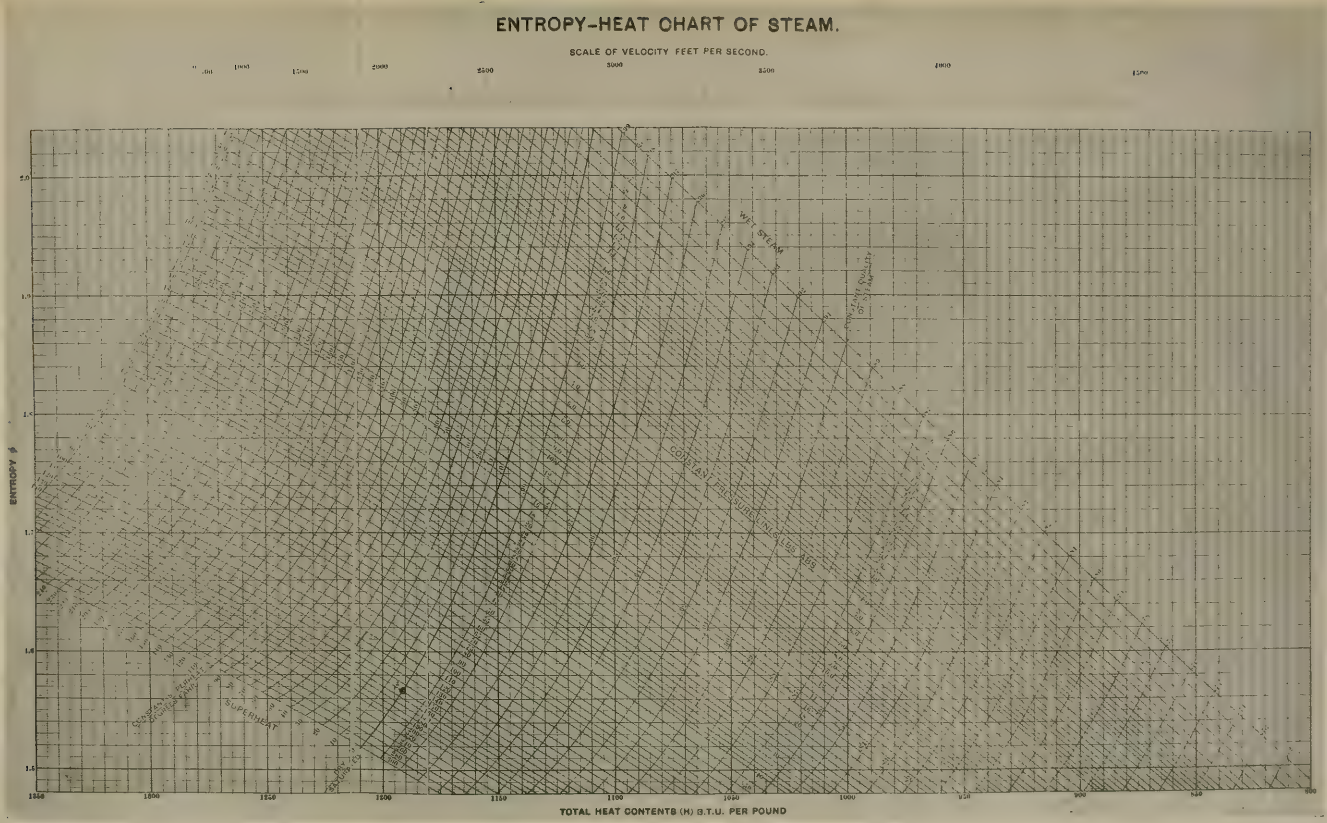
De Laval Turbine.

De Laval's turbine, as has been pointed out, consists of a single row of blades which absorb the velocity obtained by a complete expansion in a single nozzle or a group of nozzles. In order, therefore, to absorb the energy due to the velocity of a jet issuing from the nozzles, it is necessary to have a blade speed somewhere approximating one-half of the velocity of the steam issuing from the nozzle, and where the steam is expanded through a relatively wide range of pressure it becomes impracticable, mechanically, to construct a turbine which with one row of blades will give sufficient blade speed to extract, with maximum efficiency, the energy from the steam.

On account of the very high speeds, therefore, at which these turbines operate, the development of the De Laval turbine has been closely associated with the construction of discs or wheels of maximum strength. The speed at which the blades, carried on these discs may move, limits their height, if the stresses in the disc are to be kept within reasonable limits.

The commendable feature in the De Laval turbine itself is its simplicity. To utilize the high rotative speeds to advantage

Fig. 12


ENTROPY-HEAT CHART OF STEAM.
SCALE OF VELOCITY FEET PER SECOND.
2000
2500
3000
3500
4000
WET STEAM
CONSTANT QUALITY OF STEAM
CONSTANT PRESSURE LINES, LBS. ABS.
SUPERHEAT
ENTROPY φ
1250
1200
1150
1100
1050
1000
900
TOTAL HEAT CONTENTS (H) B.T.U. PER POUND

commercially, however, it is necessary to supplement the turbine with suitable reduction gearing so that the turbine unit, consisting of turbine and gear, must be, for the sake of comparison, taken together, when its advantages and disadvantages are put side by side with the Curtis, Rateau or Parsons turbine.

Owing to the high stresses encountered in this type of turbine the diameters of the wheels are relatively small, and the materials used exceptionally good.

The following table gives a good idea of the relative proportions of several different De Laval machines:

Horsepower	5	30	100	300
Revolutions per minute	30,000	20,000	13,000	10,000
Diameter to center of blades, inches	3.94	8.86	19.68	29.92
Blade speed, feet per second	516	775	1,115	1,305

Owing to the high bade speed required in the De Laval turbine, a substantial blade fastening is required. The blades are made of drop forged steel and have bulb shanks fitted to suitable slots in the wheel. The shrouding of the blades is integral with them. It is exceedingly difficult to construct a high-speed wheel so perfectly balanced that its center of gravity will coincide with the geometric center of the shaft with which it rotates. To overcome this difficulty, the De Laval turbine is constructed with a long, slender shaft which, as the speed of the wheel increases, yields somewhat and allows the latter to assume its own position of rotation about its center of gravity. The difficulties surmounted in balancing these high-speed wheels may be better appreciated by the statement that the weight of one ounce attached at the circumference of the wheel of a 300-horsepower turbine will produce an unbalanced centrifugal force of nearly 2700 pounds.

It will be apparent that the capacity of the De Laval turbine is proportional to the amount of nozzle area available, and that such nozzle area is limited by the periphery of the disc and the height of the blades. Also, as the height of the blades increases, the load on the disc rim increases, so that a point is reached beyond which the stresses in the disc become impracticable; thus the capacity of the De Laval turbine is limited by the size of the wheel permissible and by the length of blade that can be used, with due regard to proper stresses in the disc, which limitations have resulted in the construction of the De

Laval type of turbine for small powers, and then only by supplementing the turbine with gearing to reduce the high rotative speeds to commercial proportions.

The advantages of this type of machine are: (1) simplicity, requiring only one disc and one row of impulse blades; (2) the absence of packing of any form to prevent the leakage of steam past the turbine elements.

The disadvantages in this type of machine are: (1) necessity for high blade speed to efficiently extract the energy in the steam; (2) on account of the high rotative speeds, the requirement of high-class materials and the necessity for careful designing to provide for the high stresses in the revolving parts: (3) the limited capacity of the machine, due to the limitation of the blades on account of the centrifugal forces; (4) necessity of reduction gearing in all cases; and (5) medium efficiency.

Rateau Turbines.

While the principle of the Rateau turbine is very old, to Professor Rateau is due the credit for its successful commercial development. The general principles of this multicellular type have been shown in the description of Fig. 6, and its construction was principally brought about by the desirability of despensing with reduction gearing to bring the shaft speed within practical commercal limits.

This turbine consists essentially of mounting on a through shaft a series of discs which carry at their periphery a row of impulse blades. This series of wheels is mounted in the cylinder casing, which has diaphragms located between the successive discs of the spindle, with suitably-arranged packings between the spindle and the diaphragms. In the diaphragms are carried the nozzles which serve to expand the steam successively, the velocity of which expansions is absorbed by the rotating blades on the several discs.

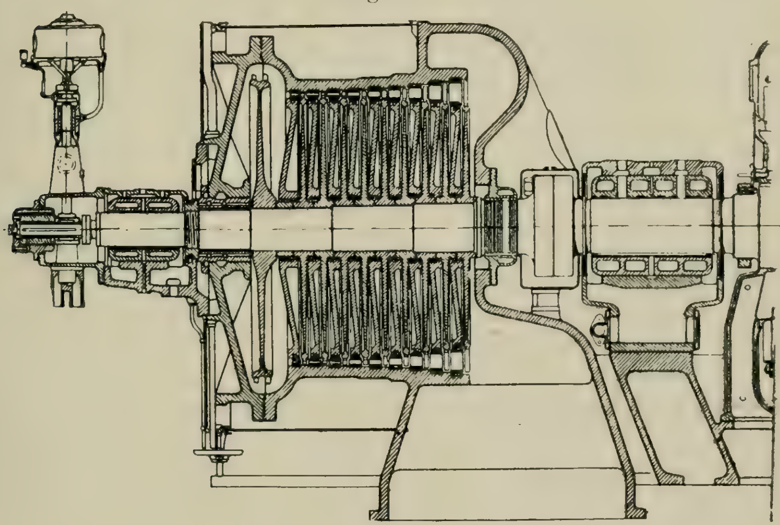
On account of the blade speed being very much lower than that required in the De Laval turbine, the fastening of the blades to the discs and the construction of the discs themselves do not require the careful design or construction that obtain in the De Laval machine. It is also practicable, on account of the slower speed of the disc and blades, to very

materially increase the disc diameter and also the blade length, resulting in a machine of very much greater capacity than would be possible with the De Laval turbine.

The nozzles in the Rateau construction are housed in the diaphragms and occupy only such portions of the periphery of the diaphragms as is required for the passage of the proper amount of steam from stage to stage. The increase in blade heights and space occupied by the nozzles on the periphery of the diaphragms admirably takes care of the increasing specific volume of steam during the expansion from stage to stage.

As in the De Laval turbine, the necessity for proper nozzle and blade design in the Rateau turbine is apparent; in fact,

Fig. 13.



A. E. G. Turbine, 1906.

owing to the multiplicity of stages, these two elements of the turbine require the closest attention to obtain the maximum efficiency; likewise, it is essential to prevent leakage of steam from stage to stage, which problem is not encountered in the De Laval construction. It is also apparent that with the disc construction in the multicellular type it is necessary to add weight to the spindle to secure that rigidity which will prevent undue bending moments on the turbine spindle, thus involving the necessity for packing at larger diameters between the vari-

ous stages of the machine, with the consequent increase in loss by leakage.

By increasing blade speeds a shortening of the machine may be accomplished, which results in a lighter spindle with less distance between the bearings, and consequently a less bending moment to disturb the proper balance of the spindle while rotating. To further accomplish this shortening in the machine the firms building the Rateau turbine have resorted in the first stages to the Curtis wheel, thus replacing several of the Rateau elements, even with some slight sacrifice in the efficiency. Fig. 13 represents a construction of this kind.

The replacement of several of the Rateau stages by the Curtis element also has the advantage of materially reducing the pressure and temperature which enter the main casing of the machine, diminishing the probability of undue distortion of the cylinder and spindle.

The advantages of the Rateau turbine as obtained by the multicellular construction are: (1) reduction of speed to commercial limits as regards the application of the turbine to driving electric generators; (2) the reduction in blade speeds, resulting in the construction of discs from ordinary commercial steel and the mounting of the blades on these discs in a simple and effective manner; and (3) the increase in the diameter of the machine to permit of large capacities by accommodating a large number of nozzles around the periphery of the diaphragms, and allowing longer blades to be used without exceeding safe limits in the matter of blade stress in the disc, due to centrifugal force.

The disadvantages in the Rateau turbine are: (1) the necessity for packing along the shaft between stages; (2) requirements of through shaft construction on which discs with holes are mounted; and (3) the necessity for nozzle control in the various stages for obtaining high economies at light loads, thus increasing the complicacy of the governor and control mechanism, or the sacrifice of economy to avoid such complication.

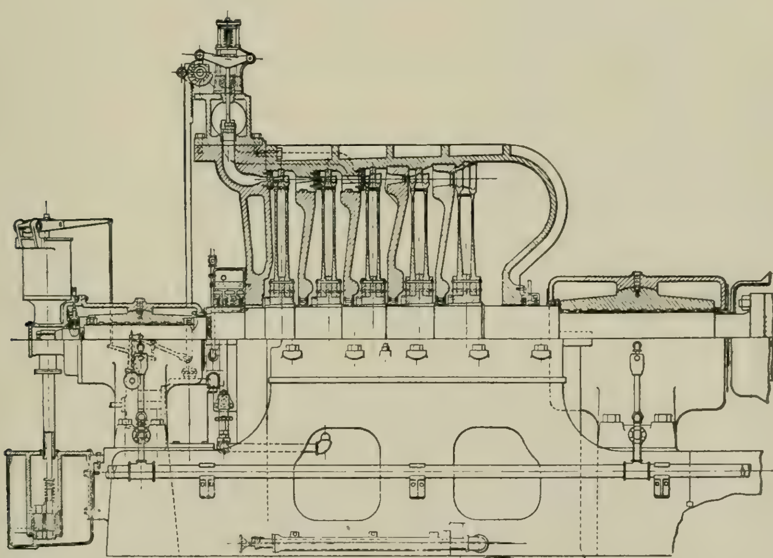
Curtis Turbines.

In the recent development of the Curtis turbine the tendency has been to recede from three or four to two moving rows of

blades per stage, on account of better efficiency resulting from the latter construction.

Each stage of the Curtis turbine usually contains one wheel carrying two, three or four moving rows of blades, and between the successive stages is interposed a diaphragm similar to the construction followed in the Rateau turbine. The general construction of the machine is shown in Fig. 14. The steam, entering the nozzles of the first stage, is expanded to high velocity, the jet first impinging on the first moving row of blades, through which it passes to the stationary row, whose function it is to redirect the jet to the second row of blades, and so on. There is, therefore, per stage, one more row of moving blades than stationary blades, and each stage, therefore, contains three or more rows.

Fig. 14.



Longitudinal Section Through a 3500-Kilowatt Horizontal Curtis Steam Turbine.

Like the Rateau turbine, the Curtis machine has partial admission in the high-pressure stages which allows better proportioning of the nozzles and blading; also, since the steam admission only covers a small part of the periphery of the wheel in the high-pressure stages, it is not necessary to continue the

stationary row of blades beyond a distance much greater than that occupied by the mouth of the nozzles.

As has been shown previously, the object of the fractional extraction of velocity in the different stages of the Curtis turbine is to increase, for a given blade speed, the exit velocity from the nozzle, and consequently the absorption of a larger amount of energy per stage than obtains in the Rateau machine, blade speeds being equal. Consequently, in the expansion of steam through a given range of pressure, less stages in the Curtis turbine are required than in the Rateau turbine, resulting in a cheaper construction and a shortening of the machine.

The pressure of the steam in each stage is the same in all parts of the chamber, because the drop in pressure occurs almost entirely within the nozzles; but, since the drop in pressure per stage is greater than in the equivalent Rateau turbine, the difference in pressure from stage to stage is proportionately greater. It therefore is essential to prevent the leakage of steam from one stage to another past the diaphragms, which results in the necessity for suitable packing between the diaphragms and the spindle.

As leakage from stage to stage results in a loss in efficiency, the diameter of the shaft is made as small as practicable and the packing as good as may be to prevent these leakage losses.

The blade wheels are usually made of forged steel discs carrying the blades in dovetailed grooves.

The principal development in this turbine has been carried on by the General Electric Company in America, by the British Thompson-Houston Company in England, and by the Allgemeine Elektricitats Gesellschaft in Germany.

The advantages of the Curtis turbine are: (1) its adaptability and simplicity to the construction of turbines of small capacity where efficiency may in a measure be sacrificed for simplicity. Thus, for noncondensing service a small Curtis turbine consisting of one stage with triple velocity extraction or three rows of moving blades gives a fairly good economy with reasonable rotative speed, as compared with the De Laval turbine, which latter would, under similar conditions, require a reduction gear; (2) the reduction of pressure and temperature of steam passing a Curtis stage results in less severe conditions for the turbine casing than with a Rateau turbine of equal blade

speeds; (3) the reduction in the number of stages required for complete expansion, as compared with the Rateau turbine, results in a shorter machine and consequently a more rigid shaft construction, together with a simplification of the turbine elements.

The disadvantages of the Curtis turbine are: (1) its inability to secure highest efficiency in the larger sizes; (2) due to its cellular construction, the necessity for diaphragms and stage packing at the shaft; (3) the necessity for discs with holes, on account of the through shaft construction, and by the necessity in the design for two moving rows of blades, additional weight imposed on the rim of the wheel, increasing the stresses in the wheel for a given blade height and blade speed, as compared with the single row of blades of the Rateau turbine; and (4) the necessity for nozzle control in the various stages, with its resulting complications where best efficiency is desirable at less than full loads.

Parsons Turbines.

The Parsons type of turbine differs from other forms of turbines principally; (1) by the total admission of steam around the narrow space between the cylinder casing and the rotating drum, as compared with partial admission of steam to nozzles in the impulse turbines previously described; (2) the stationary and revolving blades of the Parsons turbine require an expansion of steam through the blades, resulting in a difference of pressure on either side of each row, while in the impulse turbine there is practically no difference in pressure on either side of the moving rows of blades in any one stage; in other words, the Parsons construction may be said to be made up of a series of stationary and rotating nozzles; (3) the governing control of the Parsons turbine must necessarily be done by throttling of the steam when light loads are required, while in the impulse turbine the governing can, on the first and succeeding stages, be controlled by cutting in-and-out nozzles or groups of nozzles.

As the spindle blades of the Parsons machine are mounted on a drum, and as there is a difference in pressure on either side of each row of blades, it is necessary to have the clearance at the ends of the blades small, to prevent undue leakage over their tips, such leakage vitiating the efficiency which could be

obtained if it could be effectually prevented. It will be seen, therefore, that with a given clearance between the tips of the spindle blades and the cylinder or the cylinder blades and the spindle the leakage would, in general, be proportional to the height of the blade so that if the blade lengths were small the efficiency of the high-pressure end of the turbine would be materially reduced.

The advantages of the Parsons type are: (1) ease of construction; (2) the high economy obtained when operating conditions are suitable for proper proportioning of the blading; (3) ability to carry variable loads with good economy; and (4) adaptability to highest efficieucy in operating when applied in large sizes.

The disadvantages in the Parsons type are: (1) loss in efficiency due to the necessity of blade-tip clearances, especially in machines of small capacity; and (2) difficulty in construction with the use of high-pressure and high superhated steam where long spindles and cylinders are required, due to slow rotative speeds or small capacities.

Westinghouse Turbines.

Through the foresight of Mr. George Westinghouse, The Westinghouse Machine Company, in 1895, became the first licensee under the Parsons patents and began the commercial exploitation of this type of machine in America some three years later. Innumerable experiments were carried on by Mr. Westinghouse to determine the best blading proportions for turbines, and a general investigation into the turbine art as it was at that time developed.

In the early experiments made by The Westinghouse Machine Company, a system of turbine elements was developed consisting of a combination impulse turbine for the high-pressure stages, and reaction or Parsons elements for the low-pressure portions of the turbine, the object of the combination being to secure, without sacrifice in economy, a more stable mechanical construction by shortening the machine and dispensing with the necessity for three balancing pistons, as obtained in the Parsons design originally exploited.

The ability of the Curtis element to extract at a given

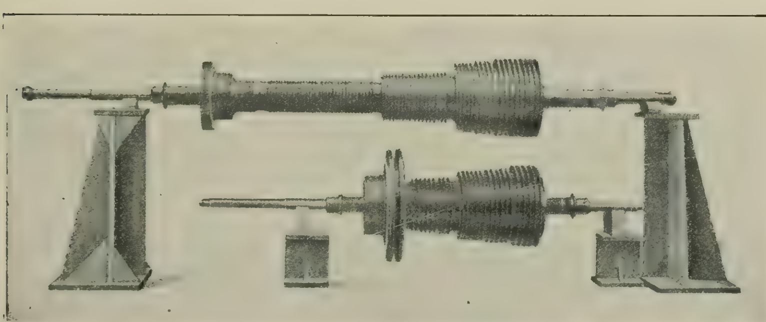
blade speed considerable energy in the high-pressure stage of the turbine with good efficiency resulted in its adoption by Mr. Westinghouse for the high-pressure portion of his machine, by which 20 per cent to 50 per cent of the energy of the total expansion is extracted, leaving to the Parsons blading in the low-pressure portions of the turbine the balance of the work to be done with the most efficient turbine elements.

The impulse wheel in this construction replaced a large number of rows of Parsons blading with equivalent economy, because in the smaller powers it was necessary in the straight Parsons machine, on account of total peripheral admission, to make the blade speeds relatively low in order that their height might be as large as practicable, to reduce the proportions of leakage by the end of the blades due to the necessary blade clearances. Such a construction of spindles is shown in Fig. 15, where the comparison is obvious.

As this development proceeded, the demand for higher capacity generators increased, and to meet this demand it was necessary to materially enlarge the low-pressure portions of the turbine, which, in some instances, required a dividing of the Parsons blading into two sections, commonly known as the double-flow low-pressure expansion.

In 1903 Mr. Westinghouse filed his application for patent on the combination impulse reaction double-flow turbine illustrated in Fig. 16. With this construction the balancing pistons

Fig. 15.

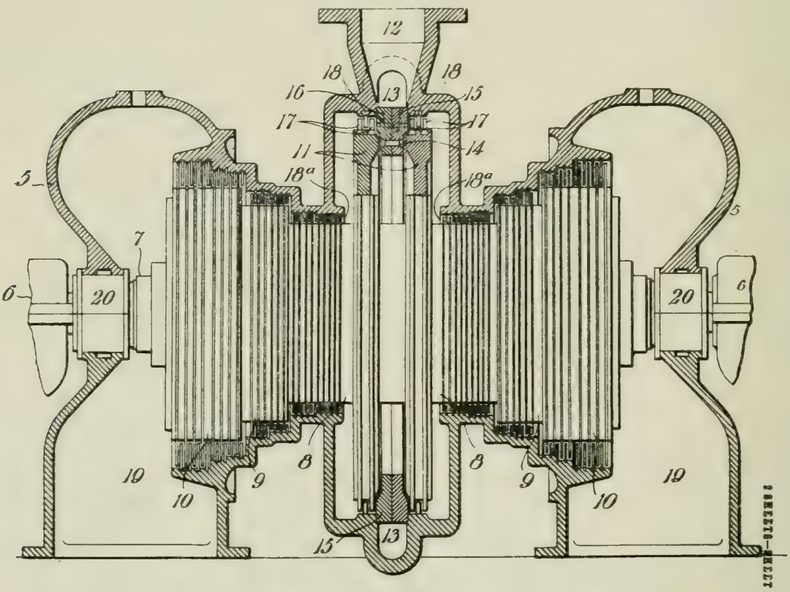


Rotors of Two 500-Horsepower Steam Turbines; Upper Spindle With Complete Reaction Blading; Lower Spindle With Impulse and Reaction Blading.

required by the straight Parsons machine were entirely dispensed with, and while for double-flow construction twice the number of blades were required as for similar conditions with single-flow, yet the application of the impulse wheel to the high-pressure stages made possible, in a great many instances, the proper mechanical design, on account of the considerable shortening of the turbine due to the introduction of the impulse wheel, thus allowing a length of spindle and cylinder of proper mechanical stability.

As this development progressed it was found advisable, on the score of efficiency, to resort to the Westinghouse single double-flow construction. This differs from the straight double-flow principle in utilizing a single Curtis impulse wheel with two rows of revolving blades, followed by a single barrel of

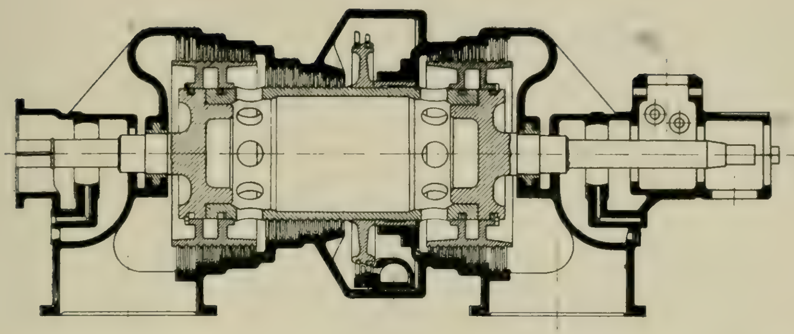
Fig. 16.



G. Westinghouse Fluid Pressure Turbine.

reaction blades, after which half of the steam is allowed to pass through the drum around a balancing piston (for the single barrel of Parsons blades) to half of a double-flow expansion of reaction blading, and thence into a double exhaust opening at either end of the turbine, as illustrated in Fig. 17. The

Fig. 17.



Turbine Assembly, Longitudinal Section. Semi-double-Flow Turbine.

intermediate reaction blading was thus allowed to be proportioned with baldes of twice the height and half the number as would have obtained had the entire reaction blading been made double-flow.

Since the efficiency of reaction blading is a function of its length, assuming the blade clearance the same, it is apparent that this single double-flow construction is adaptable to turbine units of moderately high capacity, depending on the rotative speed. This construction is now used in turbo-generator units for alternating current from 3000 to 15,000 kilowatts at speeds of 1500 to 1800 revolutions per minute.

In the development of the high-powered turbo-generator units (above, say, 10,000 kilowatts at 1500 or 1800 revolutions), owing to the large volume of steam handled, the best proportioning results by making the reaction blading double-flow with a Curtis impulse wheel carrying two rows of blades and utilized in the high-pressure portion of the turbine. Here the reaction blading may be operated at sufficiently high blade speeds to materially reduce the number of rows and make a comparatively short machine, notwithstanding the fact that twice the number of rows of blades are required on account of the double-flow principle than would be necessary if single-flow elements were resorted to. Fig. 18 shows such a construction for a machine of 15,000 kilowatts, maximum rating at 1800 revolutions per minute.

These various constructions have, as will be seen, their

particular field of usefulness, depending on the operating conditions and the speeds for which the turbines are designed.

The great importance in the turbine art of this combination turbine has been realized principally in the past five years in the field of electric-power generation, because it gives great flexibility and permits the use of high pressures and high superheats without the deleterious effect these operating conditions might impose with the more difficult mechanical construction of long cylinders and spindles subjected to wide ranges of pressure and temperature.

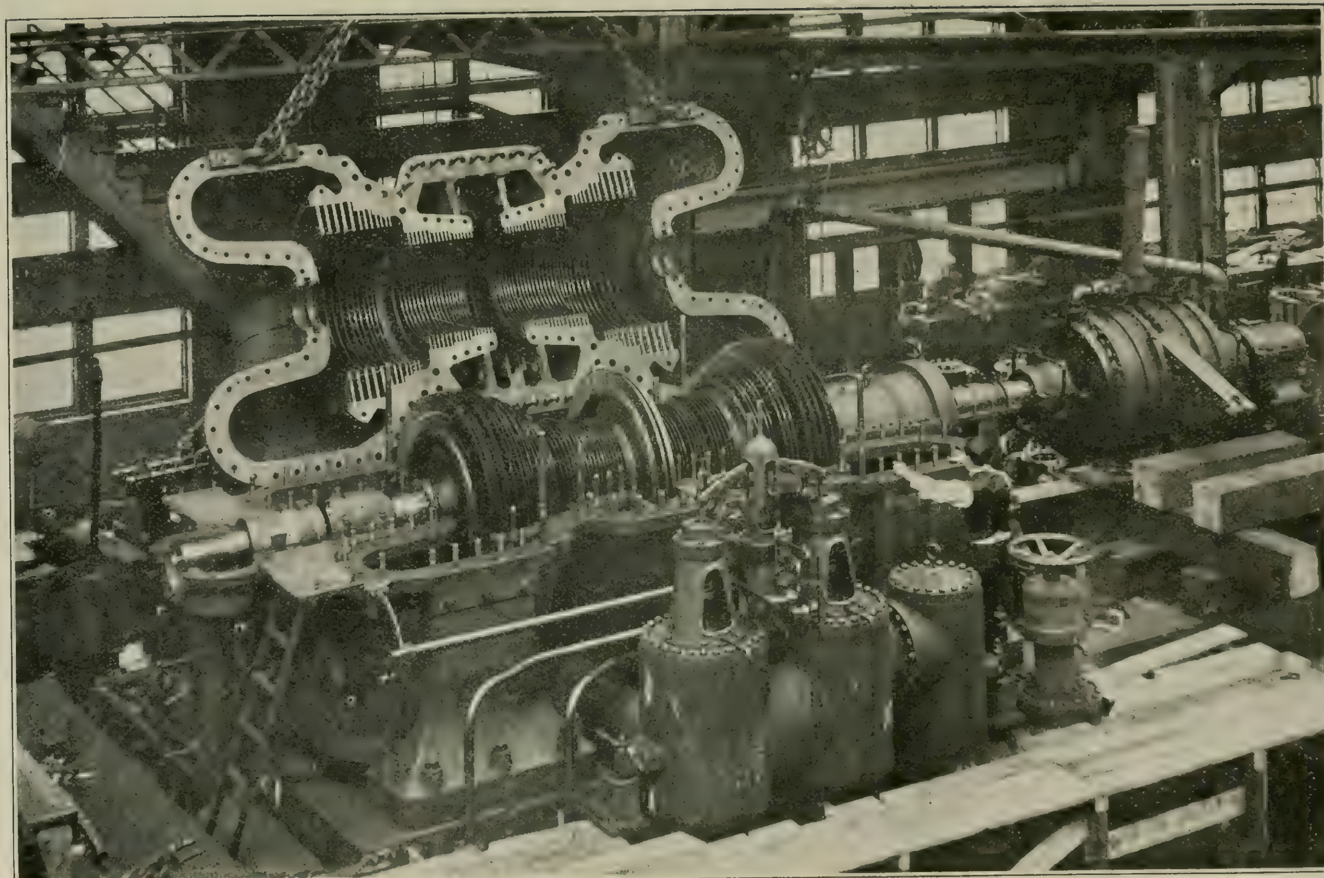
The great flexibility of reaction blading over wide variations of pressure distribution, and its adaptability especially to handling large volumes of steam efficiently, make its application particularly desirable in the low-pressure portions of turbines. There are, however, operating conditions now arising in power-plant development which make more suitable the adoption of reaction blading for the high-pressure portion of turbines than has heretofore obtained. This condition has been particularly brought about by the development of the alternating-current generator to operate at high speeds, generating large power.

For example, the most economical combination for a 30,000 kw. unit is the cross-compound Westinghouse reaction turbine with the high-pressure portion running at 1500 revolutions and the low-pressure portion at 750 revolutions. With this arrangement the highest efficiency is obtained, because with the large volumes of steam required to develop the high power and the ability to combine the unit into high—and low—pressure cylinders, running at 1500 and 750 revolutions per minute, gives the condition for best blading proportions throughout the turbine without departing from standards of practice already established. This machine would be very remarkable for its high efficiency, which it is believed could not be reproduced with any other known form of turbine. The construction, however, is considerably heavier than a single unit, and would be more costly to construct and install.

Economy.

In order to compare the efficiencies which can be obtained with the Curtis, Rateau, and Parsons machines, reference is

Fig. 18.



15,000-Kilowatt Turbine. Built for the City Electric Company, San Francisco.

made to Figs. 5 to 11 inclusive, and to the consideration that the maximum efficiency for certain blade speeds in any type of turbine is dependent on (a) design of the blade elements, (b) the relative ratio of the velocity of the blades to the velocity of the steam (c) the capacity of the turbine, and (d) the operating conditions.

Let Sb = mean blade speed,

Let Ss = mean steam speed,

Let E = blade efficiency.

If steam is admitted to a wheel with one row of impulse blades (Fig. 5), at a certain speed, Ss, and the blades are revolved at different speeds, Sb, theoretically, the efficiency is at a maximum for a certain blade speed given by the ratio.

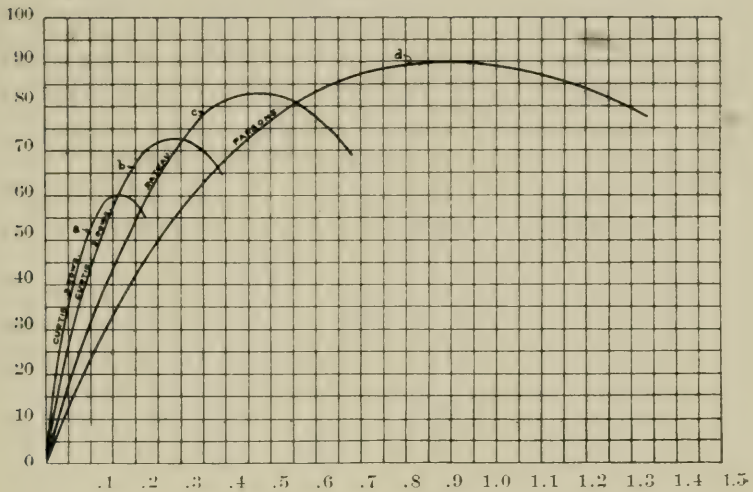
$$\frac{Sb}{S_s} = \frac{\text{mean blade speed}}{\text{mean steam speed}} = \frac{1}{2}$$

For any other ratios of $\frac{S_b}{S_s}$ the efficiency will be smaller, becoming zero when S_b = zero and when $S_b = S_s$.

The actual maximum efficiency and the ratio $\frac{S_b}{S_s}$ at which it is obtained depend mainly on the angles of the blades and the frictional losses in the machine. Curve C, Fig. 19, represents a fair average of test results actually obtained in well-proportioned Rateau blading, the maximum efficiency being 82½ per cent for $\frac{S_b}{S_s} = .47$ approximately.

For impulse wheels with two rows of moving blades the maximum efficiency is obtained for $\frac{S_b}{S_s} = .28$ approximately, as shown on curve b, Fig. 19, such maximum efficiency being 72½ per cent.

Fig. 19.



$$\frac{Sb}{Ss} = \frac{\text{Blade speed.}}{\text{Steam speed.}}$$

Efficiency curve. Parsons, Rateau, and Curtis Wheels.

For impulse wheels with three, four, or five rows of blades the maximum efficiency is obtained for $\frac{S_b}{S_s}$ less than 1/6, 1/8, and 1/10 respectively. Of these, however, only the impulse wheel with three rows of blades is of practical importance, the actual efficiencies obtainable being given by curve a, Fig. 19, showing a maximum efficiency of 60 per cent for $\frac{S_b}{S_s} = .17$ approximately. The efficiency of impulse wheels with more than three rows of moving blades is less, and they are therefore not used except in cases where efficiency becomes a secondary matter.

For reaction turbines with multiple stages properly proportioned, and with relatively large capacities, the maximum efficiency is obtained for $\frac{S_b}{S_s} = .9$ approximately, at which the efficiency obtained on test has reached 90 per cent with cor-

responding reductions when greater or less values of $\frac{S_b}{S_s}$ are used, as given by curve d, Fig. 19. The total pressure drop with the best efficiency obtainable must have; one wheel with three rows of blades, maximum efficiency 60 per cent; or three wheels with two rows of blades, maximum efficiency 72½ per cent.; or twelve wheels with one row of blades, maximum efficiency 82½ per cent; or forty-eight rows of reaction blades with a maximum efficiency 90 per cent.

From a comparison of these efficiency curves it is evident that the reaction blading is most desirable for the low-pressure portions of turbines where the blade heights become suitable for maximum efficiency, due to the reduction in the percentage of leakage loss, which vitiates the efficiency of the blade in proportion to such loss and consequently becomes greater as the height of the blade becomes less. With, therefore, a blade clearance of ten-thousandths of an inch in the low-pressure portion of a reaction turbine with blades ten inches in length, the loss would be approximately four-tenths of one per cent. If, however, the blades were one inch in length, the loss would be approximately four per cent; and as the capacity of the turbine diminished, requiring smaller blade heights, the leakage per cent. would have sufficient vitiating effect on the economy to warrant the introduction (in place of the reaction blading in the high-pressure stages) of a Rateau or Curtis element to get equal efficiency and the large initial drop in pressure which is desirable for mechanical reasons, given elsewhere in this paper. On the other hand, where the volume of steam, and consequently the capacity of the turbine, becomes great, on the score of efficiency, the impulse elements in the high-pressure stages can be dispensed with to advantage because the reaction blading gives under such conditions, reaction blade proportions for maximum efficiency.

When comparing the performance of turbines, the Rankine cycle efficiency is a more correct basis than the water rates obtained on tests, because if the operating conditions are not similar the comparison of water rates is an unfair one, unless proper correction factors are applied.

Turbines are generally designed for given operating condi-

tions, involving (a) quality of steam (superheat), (b) pressure, and (c) vacuum, and the correction for the change in these operating conditions as applied to a given machine must be taken into account when a comparison of the steam consumption of different machines is made.

Field of Application of the Turbine.

In the past six years the field of application of the turbine has been wonderfully increased, and the flexibility inherent in its construction has been developed by its adoption to: (1) noncondensing operations, (2) utilization of low-pressure steam, (3) reducing or bleeder turbines, and (4) mixed-pressure turbines.

In general, it may be stated that the distinguishing feature of these applications resolves itself into expansion of steam to and from atmospheric pressure.

Space will not permit a lengthy discussion of the various types of these special cases of the complete expansion turbine, except to say that conditions are arising to continually broaden the field of application of these special machines. Some general considerations of the designs of such machines obtain, however, which may be briefly stated as follows:

Noncondensing Turbines.

The noncondensing turbine may be made for any given condition, utilizing either the reaction or impulse machine with approximately the same efficiency, except where relatively large capacities are demanded, in which case the reaction turbine would have the advantage in efficiency. Since a noncondensing operation would require approximately twice the amount of steam for a given output as would be necessary with a complete expansion turbine, opportunity would be afforded for better proportioning of the reaction blading to give maximum efficiency, and, due to the incomplete expansion, a relatively short spindle would result on account of a smaller number of rows of blades being required to absorb less than half of the total energy drop occurring in a complete expansion machine.

Low-Pressure Turbines.

In a low-pressure turbine design, the reaction elements again lend themselves admirably to the efficient extraction of the energy of low-pressure steam, because, for a given output, the blade proportions of the low-pressure turbine would be practically twice the capacity of those required in a single expansion turbine, resulting, as in noncondensing operation, in blade proportions of maximum efficiency, a short, simple construction of the spindle and cylinder, and (with moderate capacity) the elimination of balancing pistons by resorting to the double-flow construction. The same arguments for simplicity would, of course, apply to impulse turbines, but the fact that reaction blading is, in general best adaptable to the low-pressure portions of any turbine should be a distinct advantage in favor of such a machine in low-pressure work.

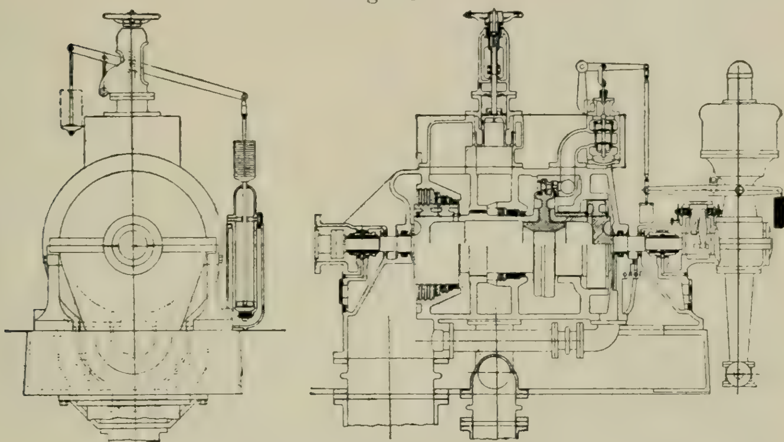
Reducing or Bleeder Turbines.

Where it is desirable to utilize steam at about atmospheric pressure for heating or industrial purposes, the turbine lends itself admirably to fulfill such a condition. It is extremely simple to bleed steam out of the turbine, at any particular pressure, in quantity proportional to the amount of flow through the turbine. Suitable automatic valves may be applied to the bleeder exhaust of the turbine to maintain (irrespective of the load the turbine may carry) that quantity of steam required to maintain a constant pressure in the bleeder line.

The conditions having been determined as to the amount of steam to be supplied from the turbine, the proportions of the elements beyond the bleeder valve are made to utilize the steam remaining under the operating conditions imposed, thus extracting the maximum amount of energy from the complete expansion of the steam required for generating power, and giving at the same time a constant steam supply at a given pressure (usually about 15 to 20 pounds absolute) for heating or industrial purposes. Likewise, with suitable valve arrangements, steam at relatively low pressures, say 15 pounds absolute, can be bled into the low-pressure portion of the turbine, and the energy from the expansion of such steam to a high vacuum may be utilized in the low-pressure portion of a bleeder turbine

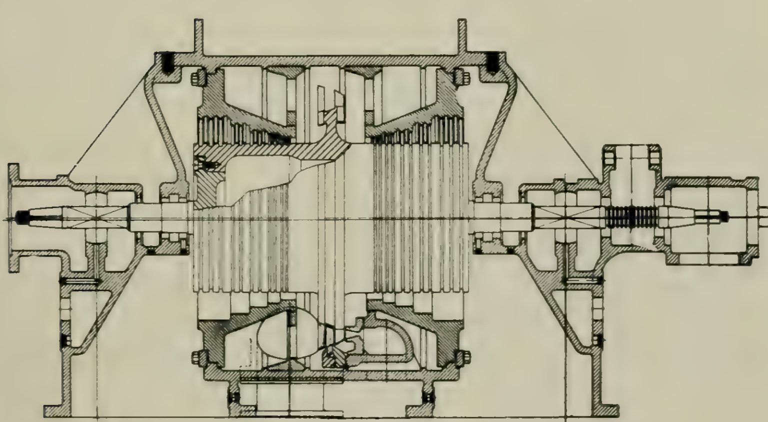
for the development of power. The bleeder valves and the initial steam valve, in the high-pressure portion of the turbine, may be governor-controlled and make, therefore, a purely automatic machine, which will take care of variable operating conditions by the governor control. An illustration of such a machine is shown in Fig. 20, where the high-pressure portion is designed with an impulse wheel and the low-pressure portion with reaction blading.

Fig. 20.



Bleeder Turbine Assembly.

Fig. 21.

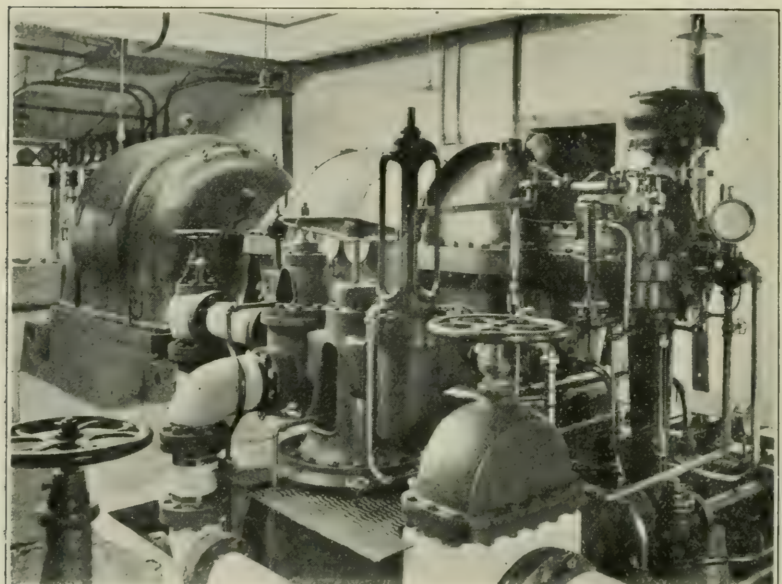


Low-Pressue Turbine With Live Steam Valve.

Mixed Pressure Turbines.

The mixed pressure turbine is really a modification of conditions requiring a low-pressure turbine. Suppose a source of low-pressure steam being available from which it is desirable to extract the energy in the development of power, and where, at certain times in the operation, sufficient low-pressure steam is not available to generate the amount of power required: To suit this condition, a low-pressure turbine is supplemented by a high-pressure element which can utilize steam at high pressure through complete expansion. When sufficient low-pressure steam is available to furnish the required power, the high-pressure steam is cut off by the governor or by other means, and when the low-pressure steam is not sufficient for the power required, the governor of the turbine admits steam to the high-pressure element to supplement the low-pressure supply for the development of the power required. This same arrangement can be accomplished with the low-pressure turbine by applying

Fig. 22.



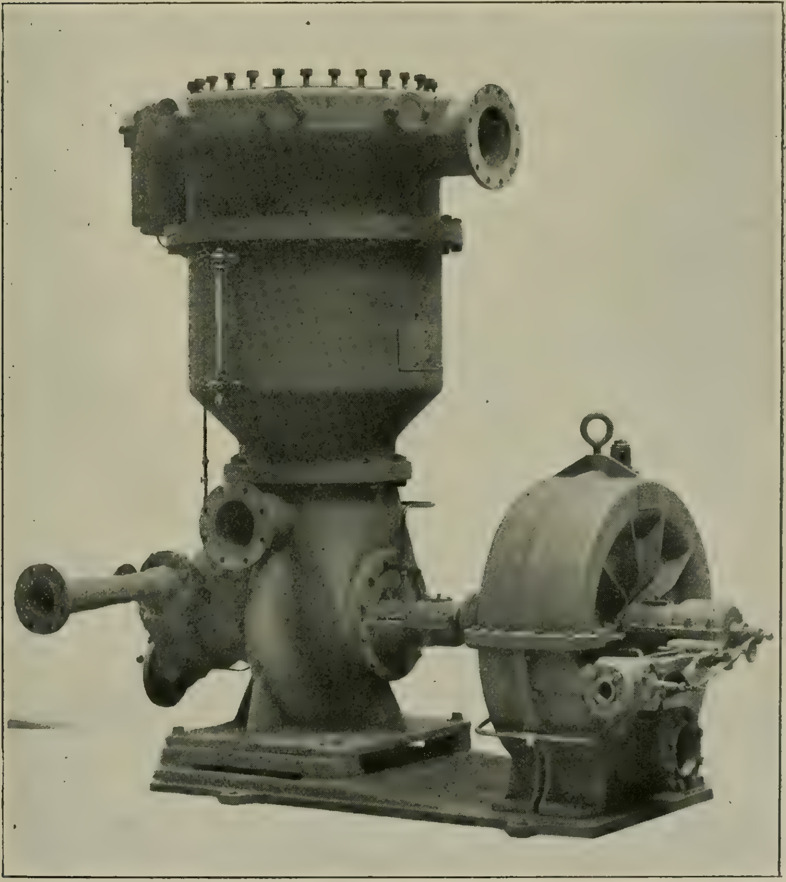
Low-Pressure Turbine With Live Steam Valve, Installed at Peace Dale Manufacturing Company, Peace Dale, R. I.

a high-pressure valve admitting steam into the low-pressure line direct. Figs. 21 and 22 illustrate machines of this construction, and the desirability of either type depends entirely on the operating conditions imposed.

Recent Miscellaneous Turbine Applications.

Due to the recent development of small turbines of relatively low rotative speeds that have recently come into quite extended use for driving auxiliaries in power plants and for

Fig. 23.



Turbine-Driven Type E High-Speed Condenser.

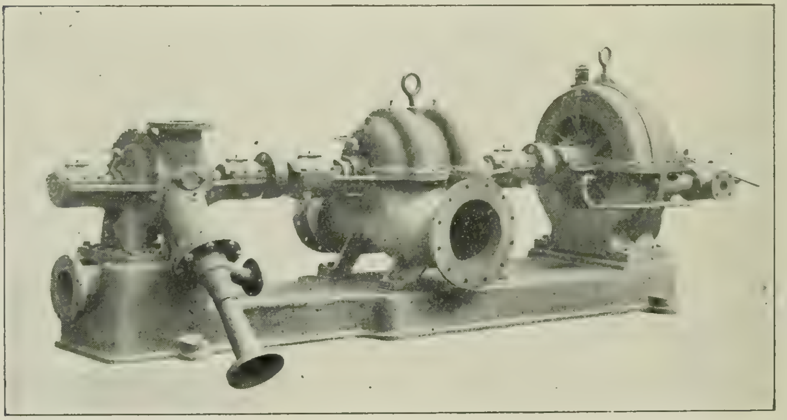
other applications, apparatus which formerly was operated by reciprocating means has been developed for rotary drive with marked reduction in the cost, weight, space occupied, and amount of steam used.

Perhaps the best example of this development has been the commercial introduction of the Westinghouse-Leblanc condenser, which, by the introduction of a rotary vacuum pump, permits the driving of the condenser circulating and air pumps by direct connection to a small turbine unit, as illustrated in Fig. 23.

The application of the small turbine to the field of centrifugal pumps is rapidly replacing the reciprocating engine, the advantages of the turbine being due to the fact that for low lift pumps and high-pressure pumps the speed for the best design is beyond that suitable for direct connection to a reciprocating engine. Fig. 24 is an application of the small turbine to a centrifugal circulating and Leblanc air pump for surface condensers. Fig. 25 illustrates a boiler feed centrifugal pump direct connected to a small Westinghouse turbine. Similarly, the small turbine is admirably adapted to the driving of centrifugal blowers.

As auxiliary apparatus for large power stations, or in places where it is important to reduce attendance to a minimum

Fig. 24.



Air and Circulating Pump Unit for 2000 Square Feet Surface Condenser, Built for Louisville & Nashville Railway Company.

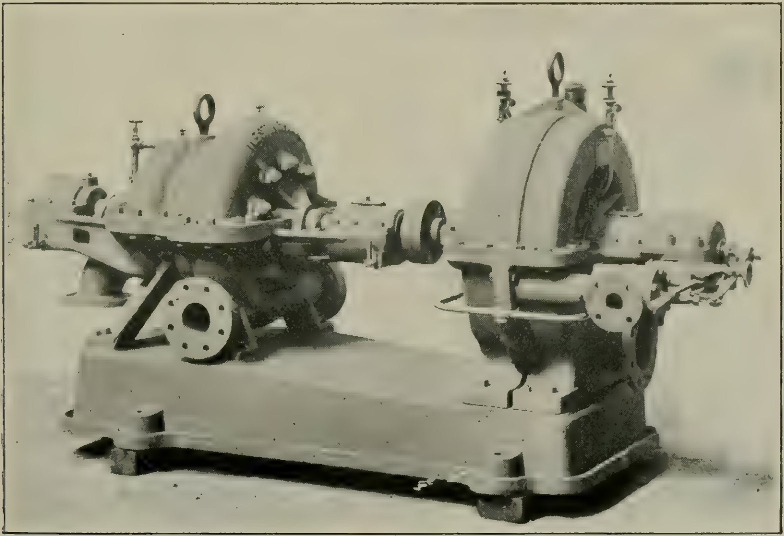
and where reliability is essential, the small direct-current turbo-generator unit is now generally accepted in place of the reciprocating engine, direct-connected or belt-driven apparatus, principally on account of its reduced size and cost, and the many advantages incident to rotary apparatus. Fig. 26 represents several sizes of these machines, from 1 kilowatt up, as manufactured by The Westinghouse Machine Company, both in direct—and alternating—current sets.

Application to Marine Service.

The application of the turbine to marine propulsion is perhaps the broadest single field for the utilization of maximum horsepower output. Until within the last few years this field was limited to approximately 5 per cent of the total merchant marine vessels, on account of the difficulty of correlating the high speed of the turbine and the relatively low speed of the ship's propeller.

It has been, of course, possible to apply turbines to the slower speed ships, but it has not been practicable to do so, because there would have been no saving in weight, space, or

Fig. 25.



Small Turbine Driving Boiler-Feed Pump.

economy over the reciprocating engine, since the turbine is essentially a machine of relatively high rotative speeds for efficient operation, while the screw propeller requires relatively low speed of rotation.

Recognizing the possibilities of the steam turbine for marine propulsion, Mr. George Westinghouse, in 1903, commissioned the late Rear Admiral George W. Melville, Ex-Engineer-in-Chief of the United States Navy, and Mr. John H. Macalpine, Consulting Engineer, to make an impartial investigation and report on the status of the marine steam turbine.

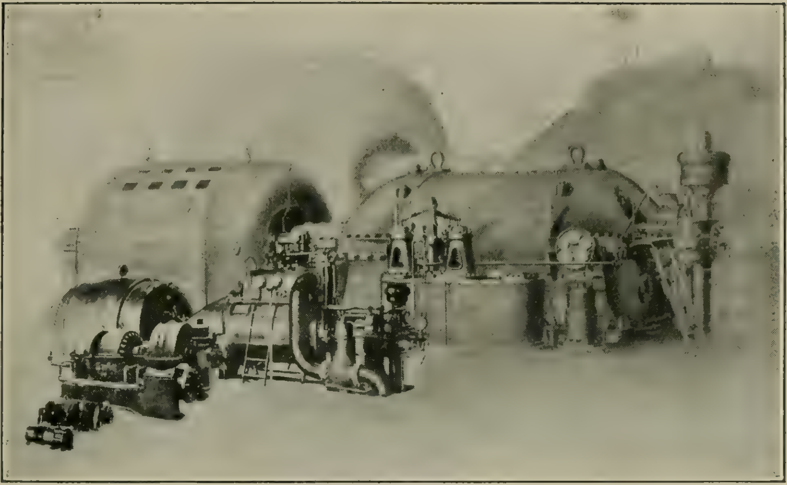
Acting on the suggestions made in this report, Mr. Westinghouse caused designs to be made for a reduction gear for large power transmission, which was constructed and tested in the works of The Westinghouse Machine Company at East Pittsburgh, after designs of Messrs. Melville and Macalpine embodying a floating frame carrying the piston, which had been shown mathematically to be necessary to the successful operation of high-speed gearing transmitting large powers.

This experimental gear transmitted under test 6800 horsepower with a pinion speed of 1500 revolutions per minute, and a gear speed of 300 revolutions per minute. These tests demonstrated conclusively that the floating frame would insure correct alignment of the gear teeth, which is absolutely essential to the transmission of large powers. It was believed that this particular design was more rigid than desirable, because the connection between the floating frame and the casing was a metallic one, and in consequence noise and vibration were not elimiated to the degree that it was believed to be possible.

As a substitute, therefore, for the Melville-Macalpine design, Mr. Westinghouse devised a hydraulically supported pinion frame having a degree of flexibility in itself, and which was supported on the main frame by oil in the hydraulic cylinders in the floating frame. This construction also allowed vertical movements of the pinion, and floating frame, which were impossible in the Melville-Macalpine design.

A test on a large scale of the Westinghouse floating frame demonstrated that this accomplished all the objects of the original inventors, and, by reason of the absence of metallic connection between the pinion frame and the casing, the noise and vibration icident to the operation of the gear were almost wholly eliminated.

Fig. 26.



1-Kilowatt to 10,000-Kilowatt Turbines.

Fig. 27 illustrates its application to the operation of direct-current generators. Fig. 28 illustrates the construction of a more recent design of marine reduction gearing where the rotation of the pinion is required for either direction. In these figures the construction of the floating frame and its pistons is readily observed.

The supporting of the pinion frame hydraulically incidentally gives a very accurate dynamometer, since the hydraulic pressure supporting the frame is proportional to the load carried; and with the knowledge of the speed of rotation, the area of the pistons supporting the pinion frame, and the hydraulic pressure, the horsepower transmitted is readily computed without the aid of special or delicate instruments, or expert observers.

This dynamometer feature should be of great service in marine work where it is very desirable to obtain the horsepower delivered to the propeller shaft.

The application of the turbine itself to marine work is a different kind of a problem than to driving electrical apparatus, for the reason that in the former case a variable speed is required, while in the latter case a constant speed is required.

In the majority of cases, after a ship is under way, the speed may be considered as constant. In naval vessels, however, it is

generally desirable to have a cruising speed, approximately one-half of the full speed. This involves a compromise in the turbine design to give relatively high economy for cruising at a propeller speed of approximately one-half that of full speed, and a power output of approximately one-eighth to one-tenth that required at full speed.

As has been pointed out previously in this paper, the efficiency of turbines increases with the power and decreases as the blade speed decreases, with the same pressure drop.

While the introduction of gearing very materially adds to the ease of design and construction of marine turbines and to their increased economy, due to the high rotative speeds, and on account of the better blading proportions, yet both theory and practice require a very different blading for marine operation than for land service with constant speed, especially where cruising speeds in marine service are desirable.

Fig. 19 shows that the efficiency of any blading diminishes as the velocity ratio diminishes or increases, beyond a certain velocity ratio which gives maximum efficiency.

Irrespective, therefore, of the diminution in power at cruising speed, the fact that the speed of rotation of the turbine is reduced one-half would, with the same energy drop, result in a very marked decrease in efficiency. If, however, the turbine be over-bladed, a reduction in the speed of rotation over that obtaining at full power will still give a high efficiency,—and the widest range in this respect, as illustrated in Fig. 19, may be obtained with reaction blading rather than pure Curtis or pure Rateau elements.

If, however, a combination impulse reaction turbine is employed for marine service, and the blading proportions are properly relegated in the impulse and reaction sections, one to the other, the reduction in efficiency in either may be offset by an increase in efficiency in the other, and consequently a more uniform water rate or efficiency may be obtained over wide ranges of speed and power. Also, the remarks already made in connection with the advantages of the combination impulse reaction turbine for electric drive hold good for the application of the turbine to naval or merchant vessels, and for these reasons it is believed that this type will predominate in the future construction of marine installations.

Fig 27

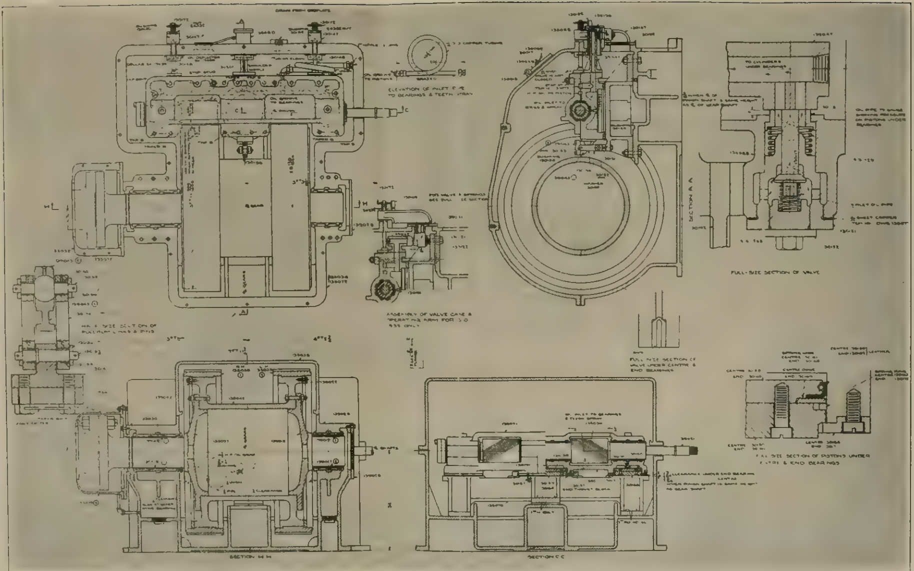
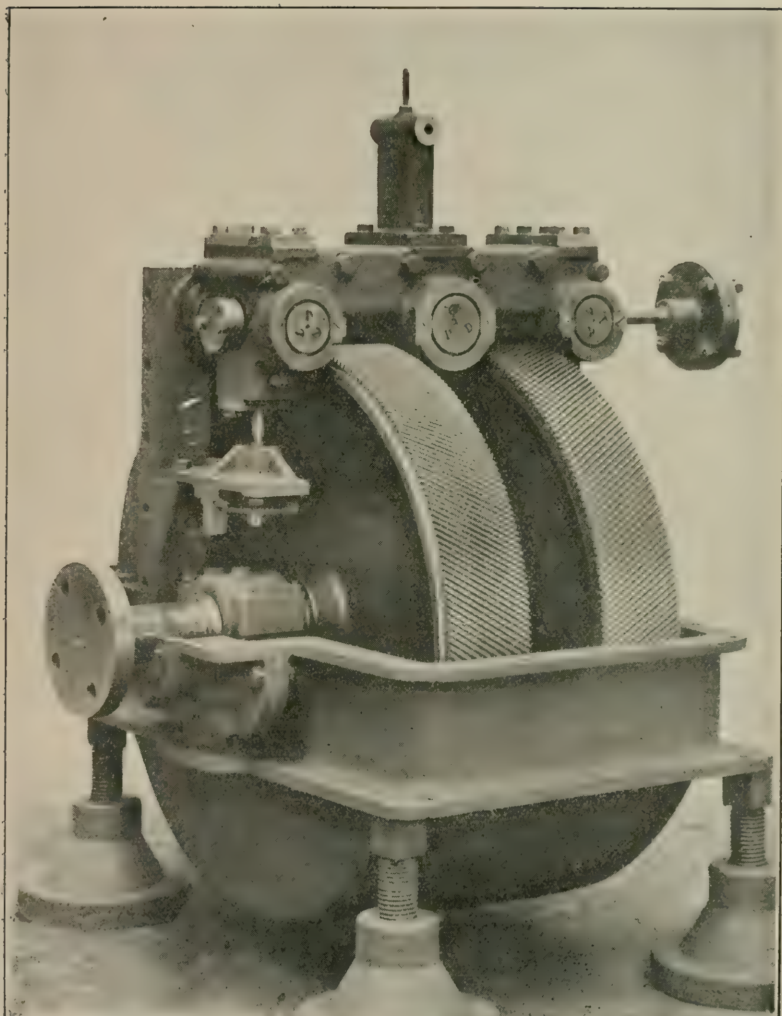


Fig. 28.



Marine Reduction Gear. Part of Cover Removed.

Reduction Gears Suitable for Slow Freighters.

The savings which may be effected in smaller vessels by the use of geared turbines are no less important than those for large express steamers. In fact, they are a great deal more important because of the greater aggregate power in medium and small size vessels. As compared with reciprocating engines, with which most moderate speed vessels are equipped, the saving in steam and coal consumption in favor of geared turbines is found to be from 15 to 25 per cent in most cases.

From a commercial viewpoint the large savings which may be obtained by using geared turbines are most attractive. No doubt they will be compelling within a short time. In some cases the first cost of geared turbines may be slightly higher than reciprocating engines, but when the savings are capitalized it is found that engines are the most expensive at almost any price. In some cases it is found that it would not pay to put in an engine, even if it were obtained absolutely free.

Advantages of Reduction Gears in Naval Vessels.

In naval vessels the military advantages of geared turbines are quite as great and important as are the commercial advantages in merchant vessels. The saving in weight and space required for the machinery makes it possible to considerably increase the gun power or armor protection.

One of the most important advantages of geared turbines for naval vessels is their high efficiency at cruising speed, in which respect the direct-drive turbine has been found lamentably lacking.

With geared turbines, the additional complication and weight of cruising turbines are not required. With respect to backing power and quick maneuvring, which are very important in naval vessels, the direct-drive turbine has not been entirely satisfactory because of the small propellers and restricted astern power. Because of the large propellers which "take hold of the water," and the ample backing power which can be obtained in high-speed turbines, the backing and maneuvring qualities of geared turbines are quite satisfactory and practically as good as obtained with reciprocating engines. This is also an important considera-

tion in merchant vessels, especially those which have to be handled around docks.

The advantages of geared turbines for propelling vessels, both naval and merchant, are of the greatest importance. Now that the reduction gear has made it possible to realize the full advantages of the turbines, its rapid adoption seems certain. A few years ago the turbine wiped out the reciprocating engine on land. It now appears that this same stage has been reached at sea, and that here also the turbine will wipe out the reciprocating engine.

Discussion.

PRESIDENT McNULTY: Gentlemen, you have listened to a very interesting and instructive address. The subject is now open for general discussion or questions.

MR. A. C. COTTON: May I ask Mr. Herr what materials enter into the construction of those gears, the bearings and the teeth?

MR. HERR: The bearings of the gears are made the same as our turbine bearings, a brass shield with babbitt lining. The material of the gear itself is plain carbon steel, as is the pinion—ordinary commercial carbon steel. We sometimes use in the big gears cast steel. It depends on the size and the ability to get rolled rims. Very large gears are made of cast steel, the pinion being ordinary carbon steel.

MR. D. J. REDDING: What is the relative efficiency or saving of coal in a 1000 h. p. turbine engine of the latest design as compared with the best type of reciprocating engine?

MR. HERR: We now design for very high vacuum, that is we design a 1000 k. w. machine for 29″ of vacuum. A steam engine that you might buy would be designed for probably about 27″. We therefore get the advantage in a turbine of the energy of that steam between 27 and 29″ of vacuum.

The theoretic efficiency of the steam engine and steam turbine, when properly designed, is about the same, but the turbine has the advantage of being able to use the steam down to a lower pressure on account of its ability to get rid of it. With a reciprocating engine it becomes a very difficult matter to design

steam ports large enough to carry the large volume of steam with high vacuum.

MR. REDDING: There is really no saving of coal on the same capacity, then?

MR. HERR: Yes there is, because you are carrying the expansion farther down.

MR. REDDING: Do you know what that is, expressed in percentage of coal used?

MR. HERR: About 15 to 20 per cent. I am figuring 4 or 5 per cent for 1 inch of vacuum. The great merit of the steam turbine as against the reciprocating engine of course is first its small size, requiring very small foundations, light and cheap. It is very much cheaper to build an equivalent power in turbines than in reciprocating engines. Also the generator is very much smaller and cheaper to build than the engine under slow speed conditions.

To give you an idea of the steam economy of a turbine, I shall select the 30,000 k. w. cross-compound, turbine shown in the illustrations. It is a very large machine and allows the proper proportioning of the blading for maximum efficiency. In this machine we get 7½ pounds of steam used per horse power hour. And that is shaft horse power and not indicated horse power. Operating conditions are very good, however, being 125 degrees superheat, 200 pounds pressure and 29″ vacuum.

MR. REDDING: You are building turbines to run on exhaust steam, are you not?

MR. HERR: Yes, we build machines that will operate on any range of pressure. You have in mind probably what we call the low pressure turbine, which takes steam at atmospheric pressure and expands it to 28 or 29″ vacuum. Take an ordinary reciprocating engine, which now exhausts at atmosphere, put in a low pressure turbine and you get twice the power without increasing your boiler capacity at all. The energy of steam from atmosphere down to 28″ vacuum is practically the same as from 165 pounds pressure to atmosphere.

MR. REDDING: So your engine comes in nicely in a power plant already installed where they run an air compressor and reciprocating engines and are wasting some of their exhaust steam?

MR. HERR: Yes. We have a good many of that kind. Now days instead of putting in a low pressure turbine we put in a mixed pressure turbine so that if you have a certain load to carry and not enough exhaust steam to carry it you can open a valve to the boiler and let in live steam and get more power. The turbine is extremely flexible and is susceptible of enormous overloads. In some experiments in the shop Mr. Westinghouse has taken a machine designed for 500 k. w. and actually got 3500 k. w. out of it. Of course he did not do that very efficiently, but it shows the enormous capacity of the machine. It is just a question of how much steam you put through it.

MR. REDDING: A question of the amount of pressure?

MR. HERR: Yes.

MR. E. NEISSEN: May I ask you something about lubrication and what you specify?

MR. HERR: We make no specification of oil, except that it be good turbine oil. There are a number of grades we recommend to our customers, eight or ten different kinds of oil that we say are samples of oil that are all right. Of course turbine lubrication is one of the things you would expect to have trouble with, yet we have practically none. It is forced feed. The turbine is equipped with an oil pump that forces the oil into the bearings and from the brassings it drains back through a cooler and is again circulated. We are running them 3600 r. p. m. and we are building them up to 12,000 r. p. m. By the aid of a reduction gear it enables you to make very efficient machines for any number of revolutions.

MR. REDDING: Is the shaft practically balanced in oil?

MR. HERR: Yes. In a high speed machine we use a bearing having a sleeve balance which consists of four tubes about 3/32″ thick and those tubes have a clearance of .004 or .005″ between each other. When the turbine is in operation there is an oil film gets between those sleeves and cushions the vibrations of the spindle. With very high speed it is very difficult to balance the rotors. On a De Laval machine a pressure of 1 oz. on the rotor of a 30,000 r. p. m. machine results in a stress of over a ton.

MR. THEO. H. HERMANSON: Does building it in varied stages increase the efficiency, do you get more benefit of the condenser?

MR. HERR: It depends entirely on how fast the blades run. If you could run a set of impulse blades up to 1700′ or 1800′ a second, would be all you need. But such a speed is entirely impracticable with what we know of materials now.

MR. HERMANSON: Is using high pressures now for marine purposes have they not some trouble and difficulty finding proper material for buckets for the high pressure stage?

MR. HERR: Of course the goodness of steam turbine design depends principally upon the detailed construction, and one of the most important details is the blading. When you get the fastenings right it is a question of taking care of the vibrations. You have a jet of steam like a stream of rifle balls going against each blade and it sets up vibrations of the blade which you have to take care of by lashing them up above the root of the blade.

MR. HERMANSON: I have seen blades almost rivetted over on account of high pressure and heat.

MR. HERR: There is no difference in pressure on the different sides of the blade in an impulse turbine; there is a slight difference in a reaction turbine. If you have superheat you have to have particular kinds of material to stand it. In this country we do not have superheat to exceed 150 degrees, which is not very much compared with German practice. They have gone as high as 300 degrees.

MR. HERMANSON: In using one of the turbines condensing is it necessary to have a different make of condenser from what you use with reciprocating engines?

MR. HERR: Not necessarily a different make, but it is necessary to have a different kind, because the condenser is what maintains the vacuum and in order to get the very best out of the turbine you ought to operate it with very high vacuum, consequently you have to have a very large amount of circulating water through the condenser to keep the temperatures down and you have to have an increased surface.

MR. HERMANSON: And a steady flow of steam would come through instead of in a steam engine an impulse every stroke.

MR. HERR: That would not make any difference. It is just a question of maintaining the temperatures correspond-

ing to the vacuum. A 28″ vacuum has a temperature of 100 degrees, F. You have to maintain the temperature in the condenser corresponding to the vacuum.

MR. HERMANSON: In reversing what makes it reverse? Is it a stationary blade.

MR. HERR: It is another turbine entirely, made the opposite hand. Your jet passes one way in one turbine and in the other turbine it passes the opposite way.

MR. HERMANSON: Has not the Curtis one that reverses by the same engine?

MR. HERR: No, he has to have separate blades to do it. He may have them mounted on the same wheel, that can be done. He has to have a separate set of nozzles arranged to discharge steam in the opposite direction.

MR. W. H. RITTS: How is the end thrust of turbine shafts taken care of on vessels and also on the gears? Does the thrust have to be taken care of on the gears, too?

MR. HERR: Yes. On a vessel the thrust from the propeller is what moves the vessel through the water. That has to be taken care of in the ship. A thrust bearing is put in for that purpose. Every turbine has to have a thrust bearing so the spindle will remain in a certain position, because the clearances are not very large. You have to keep the spindle in proper relation to the stationary blades. We make turbines with what is known as the Kingsbury thrust bearing, doing away with balancing pistons. That thrust bearing will carry as high as 10,000 pounds to the square inch of bearing surface. It consists of a collar on the spindle against which a number of shoes bear, the shoes being held in position on ball seats which allows them to align themselves to the collar and the whole thing runs in oil, the speed of the collar on these shoes creating an oil film between them. We have tested those bearings up to a thrust of 10,000 pounds to the square inch, which is a very creditable showing for a single bearing.

MR. A. E. ANDERSON: Is there a proportion between pressure and velocity?

MR. HERR: Yes. If you expand steam from 165 pounds down to 28″ vacuum the speed of the steam issuing from the nozzle is over 4000′ a second. If you expand it from 165 pounds

to atmosphere it would be something like 2,000′. In a turbine instead of the energy of the expansion being taken up by pressure, like in a reciprocating engine, it converts all that energy of pressure into velocity and the turbine blades absorb that velocity. The principle is of course very different from that of a reciprocating engine. One operates by pressure, the other by velocity.

MR. STUCKI: I fully agree with what you have just said about doing away with shocks and if you could eliminate trouble with the blades there would be absolutely nothing to put the machine out of order. With the reciprocating engine on the contrary we have always shocks which besides destroying energy will also tend to destroy the machine itself.

MR. HERR: That is correct.

MR. STUCKI: What condenser do you use to get such high vacuums?

MR. HERR: We build all kinds. We build the barometric, the jet condenser and the surface condenser. We build what is known as the Westinghouse LaBlanc condenser, using a rotary air pump, which allows the use of a turbine in the air pumping apparatus. For a 1,000 k. w. turbine the air pump is about 15″ in diameter and 4″ wide.

MR. STUCKI: How high vacuum do you get?

MR. HERR: It depends entirely on the temperature of the circulating water. If it is like it is now in the river we can get 29.5″.

MR. STUCKI: I remember well some years when we had trouble to retain 28″.

MR. HERR: It is quite common now. All turbine work has gone to the 28″ basis. Of course they get just as much vacuum as they can. The energy of the steam at those high vacuums is enormous compared with any other range in pressure. You will recollect the chart I showed, the energy in expanding from 28 to 29″ is as much as it is from 26 to 28″.

MR. H. H. RYDE: What is the clearance on a 1500 k. w. motor?

MR. HERR: You refer to a Parsons blades? The clearance between the rotating blade and the cylinder and the stationary blade of the motor is the same, of course. It depends

entirely on diameter. For a 1500 k. w. machine we would use about .008" in the high pressure and about .012 to .014" in the low pressure. The longer the blades and the bigger the diameter the bigger the clearance can be without affecting the efficincy. That is one of the things about reaction blading that I spoke of during the talk, that if you have not sufficient steam volume to warrant good length of blade, the reaction blading is not very efficient. But when the conditions are right for proper reaction design there is no kind of blading that will beat it for economy. You have to keep your clearance within reasonable limits because that is a source of loss.

MR. RYDE: What provision do you make to line it?

MR. HERR: The spindle is made of cast steel. The blades are inserted in dovetailed grooves with upset ends and a packing piece, a double compound wedge which makes a very rigid fastening. Then the ends of the blades are ground to the proper diameter to set into the cylinder bore allowing for clearance. Then we put the machine together and put the cover on the spindle and move it up and down to determine the amount of clearance we have under the blade construction. We do that not only cold but hot.

MR. J. C. WARNE: What is the economy in floor space between the turbine and the reciprocating engine on say a 1000 h. p. installation?

MR. HERR: I could give you a better example of an actual case. This big 30,000 k. w. machine, cross compound, that I showed you goes in the same space as a 6,000 k. w. reciprocating engine, and with about 1/10 the foundation. It is any way 5 to 0. That is a very interesting case. Three of those machines are being installed in the InterBorough Rapid Transit plant at 74th Street, New York City. Those three machines replace three reciprocating engines of 6,000 k. w. each, these being 30,000 k. w. each.

Another very interesting thing about that installation which indicates the progress made in the art is as follows: That station was built about twelve years ago. The reciprocating engines were put in by the Allis-Chalmers company and the generators were furnished by the Westinghouse Electric Co. They were at that time probably the highest type of reciprocating engines

ever built in this country. They are now, as far as that goes. They are very fine machines and have performed very brilliant work for the company. But they had to increase their power plant. They could not buy additional real estate for power house extensions because it was very expensive. By installing steam turbines they get five times the power in the same space and they get it for practically the same money they paid for these 6,000 units twelve years ago.

Another interesting thing which is a recent development in power house work is that in that same plant they had the boiler capacity for these 6,000 k. w. machines. They have not increased their boiler capacity at all but they have put underfeed stokers in place of hand firing, and the boilers do 300 per cent above rating, so that carries them overpeak loads without any expense for an additional boiler plant.

MR. RYDE: Could you give us the cost of a 1500 k. w. turbine complete with condenser?

MR. HERR: A 1500 k. w. turbine complete with condenser and all the accessories would be about $25,000. One of the great developments in turbines has been the increase in speed. The turbine is essentially a high speed machine. It has to run at high speed in order to be efficient. One of the things that has held it back in the electric art has been the inability to build generators to run at as high speed as the turbine ought to run. Now that is not so, however. The first turbines built by our Company were the turbines installed at the Brake Company, 400 k. w. and they were considered the largest that the generator could be built at that speed. In fact they had to change the rotating member from the armature to the field to do that. But now we build a 3600 turn machine up to 5,000 k. w.

MR. A. J. SCHAAF: What expansion ratio was that Allis-Chalmers engine?

MR. HERR: I do not know, I suppose about 1 to 4.

MR. SCHAAF: How would it be if you had it 1 to 10?

MR. HERR: You could not get the steam out of the exhaust port.

MR. SCHAAF: We are using one set now, ratio 1 to 10.

MR. HERR: You do not use a 29" vacuum.

MR. SCHAAF: No, 27".

MR. HERR: You would make it better if you would make it triple expansion at that ratio.

MR. SCHAAF: I don't think so, we have 12" high pressure cylinder, 38" low 5' stroke and getting good results.

MR. HERR: I do not know what that expansion ratio was. I think it must have been higher than 1 to 4.

MR. SCHAAF: 1 to 4 is in general use and 1 to 5 is the highest we have used heretofore.

MR. NEISSEN: Is there any economy for a turbine in a small installation, below 300 h. p.?

MR. HERR: Yes, we think there is with reduction gear. We are developing that now.

MR. RYDE: Is the small turbine good for excitation purposes?

MR. HERR: Yes. Economy does not make so much difference because you use feed water heating and you have to have temperature any way.

MR. A. C. COTTON: What is the best efficiency you can obtain from a condensing turbine of the best type? 500 to 1000 k. w.

MR. HERR: We get about 21 pounds per horse power at 150 pounds pressure and atmosphere exhaust. 21 pounds of steam per shaft horse power.

MR. COTTON: What is the largest single shaft turbine?

MR. HERR: We have a 25,000 k. w. There are a number of those in operation now. We think we can build 50,000 in one cylinder.

MR. L. E. ENDSLEY: What size steam pipe would you use for a 1500 k. w.? 7 or 8"?

MR. HERR: I could not tell you exactly.

MR. ENDSLEY: Smaller than a reciprocating engine?

MR. HERR: Not very much, no; about the same.

MR. RYDE: Did you say when they put the under-feed stoker in they increased the boiler power 20 per cent?

MR. HERR: They are Babcock & Wilcox boilers. You buy that boiler rated at 500 h. p. They put the under-feed stokers under that boiler and they got three times that rating, 1500 h. p., a horse power being 33 pounds of steam.

MR. SCHAAF: You have to put on some induced draft.

MR. HERR: Yes, forced draft.

MR. W. P. RICHARDSON: I would like to ask if there is any appreciable erosion due to the impact of high velocity steam on the vanes?

MR. HERR: Yes. That has been a matter of development in the turbine art. We have used different kinds of material for our blading. When Mr. Westinghouse secured the license to build Parsons turbines we used his metal, Parsons metal. Then we abandoned that and used steel because we at that time had some broken blades which we did not then know the reason for. It was due to vibration and not because the material was particularly weak. Then the steel corroded very badly, especially on the low pressure end where you begin to get moisture. Then we used a blade which was covered with a copper coating, steel inside and copper on the outside. That was worse than the steel. Then we went about seven years ago to phosphor-bronze, which we are using today and we have had very good success with it. Of course blades will not last forever.

MR. HERMANSON: In using different metal in the blades, due to difference in expansion of the two metals are you liable to have trouble only allowing such small clearances?

MR. HERR: No, because we take those clearances when the turbine is hot.

MR. STUCKI: How do you coat those steel blades with copper?

MR. HERR: Some man came in with a sample of wire coated with copper. I do not know how he did it. I think it was rolled on. But it did not do for turbine use, it corroded very badly, possibly due to some electrolytic action, we have used cast bronze and we have used drawn bronze and pure nickel, and now we use nickel steel made in the electric furnace. A pure nickel blade makes a beautiful blade but it costs $1.00 a pound.

The General Electric Company used Monel metal, but I understand they now use nickel steel. Monel is a very fine metal but very treacherous and very difficult to forge.

PRESIDENT McNULTY: Gentlemen, we have had a

very good discussion of this subject. I will ask Mr. Herr to close with any additional remarks he may wish to make.

MR. HERR: I do not know that I have anything more to say.

MR. T. M. NEEL: Is there any loss due to the condensation of steam in passage as there is in the reciprocating engine, due to condensation and re-evaporation?

MR. HERR: No, there is no cylinder action in the turbine because the pressure in the various stages under constant load remains constant. They do not get hot and then cool and then hot and cool as in a reciprocating engine. In a reciprocating engine that is one of the greatest sources of loss. This condensation and re-evaporation which you get away from entirely in the turbine.

If there is no further discussion, I am finished and I thank you very much for your attention.

MR. H. H. MAXFIELD: This Club is certainly to be congratulated upon having this subject presented by Mr. Herr this evening. I think without question it is one of the most instructive addresses we have ever had before the Club. I would like to move a rising vote of thanks to Mr. Herr.

The motion prevailed by unanimous vote.

There being no further business,

ON MOTION, Adjourned.

J. B. Anderson
Secretary.

In Memoriam

D. H. HASLETT

DIED

JANUARY 1, 1915

RAILWAY CLUB NOTES

The following subjects were presented and discussed by the several Railway Clubs during the month of January, 1915:

New York Railroad Club, Harry D. Vought, Secretary, 95 Liberty Street, New York, N. Y.

SUBJECT: Tonnage Rating and Results Therefrom, by J. M. Daly, General Superintendent Transportation, Illinois Central Railway Co.

Central Railway Club, Harry D. Vought, Secretary 95 Liberty Street, New York, N. Y.

SUBJECT: The International Railway System, by Edward J. Dickson, Vice President, International Railway Co.

St. Louis Railway Club, B. W. Frauthenthal, Secretary, Union Station, St. Louis, Mo.

SUBJECT: Protecting the Railway Employe from Loan Sharks, by W. Scott Hancock, Assistant General Attorney, Missouri Pacific Railway Co.

New England Railroad Club, Wm. E. Cade, Jr., Secretary, 683 Atlantic Avenue, Boston, Mass.

SUBJECT: Making Friends, by Roy V. Wright, Managing Editor, Railway Age Gazette.

Western Railway Club, Jos. W. Taylor, Secretary, 1112 Karpen Building, Chicago, Ill.

SUBJECT: Economies in Freight Car Repairs, by H. H. Harvey, General Car Foreman, C. B. & Q. Railway.

Canadian Railway Club, Jas. Powell, Secretary, Chief Draftsman, G. T. Railway, Montreal, Canada.

SUBJECT: What Can Be Done to Prevent Damage to Freight, by G. C. Ransom, Chairman, Canadian Freight Association.

Richmond Railroad Club, F. O. Robinson, Secretary, c-o C. & O. Railway, Richmond, Va.

SUBJECT: Development of Electrical Equipment on Railways and Street Cars, by J. G. Laying, General Electric Company.

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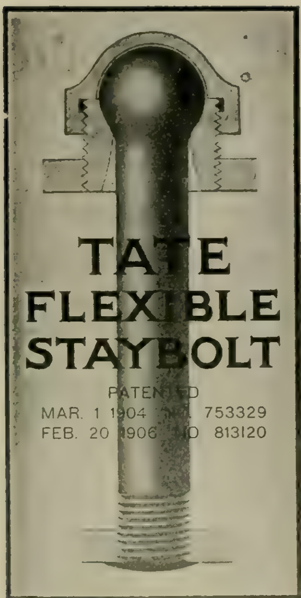

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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING, FEBRUARY 26, 1915.

The regular monthly meeting was called to order at the Monongahela House, Pittsburgh, Pa., by Vice-President J. G. Code, in the absence of President F. M. McNulty, at 8:00 o'clock, P. M.

The following gentlemen registered:

MEMBERS.

Adams, Chas. F.
Amend, G. F.
Anderson, A. E.
Anderson, J. B.
Barth, J. W.
Babcock, F. H.
Bealor, B. G.
Bell, Jas. E.
Berghane, A. L.
Blair, H. A.
Boehm, L. M.
Bohannon, G. L.
Boyer, Chas. E.
Bradley, W. C.
Brewer, W. A.
Brosemann, W.
Buffington, W. P.
Butler, W. J.
Byron, A. W.
Cassiday, C. R.
Caton, S. W.
Chapman, B. D.
Clark, C. C.
Code, J. G.
Cooper, F. E.
Cornelius, R. D.
Courson, C. L.
Courtney, H.
Courtney, D. C.
Crawford, D. F.
Cromwell, S. A.
Dalton, C. R.
Dambach, C. O.
DeArment, J. H.
Dickinson, F. W.
Emery, E.
Endsley, L. E.
Eriksson, E. S.
Farquhar, L. C.
Fogle, E.
Fulton, A. M.
Gale, C. H.
Grieff, J. C.
Gross, C. H.
Guay, J. W.
Haines, E. K.
Hair, H. J.
Haynes, J. E.
Hays, M. D.
Herrold, A. E.
Hoffman, C. T.
Holbrook, W. H.
Holt, Jas.
Howe, D. M.
Huchel, E. W.
Hudson, W. L.
Huff, Geo. F. Jr.
Hunter, J. A.
Jameson, A. A.
Johnson, W. A.
Kinch, L. E.
King, Wm. R.
Kleine, R. A.
Knickerbocker, A. C.
Knox, Wm. J.
Lanahan, Frank J.
Lang, W. C.
Lansberry, W. B.
Laughner, C. L.
Laylin, M. H.
Lehr, H. W.
Lidstone, F. J.
Lobez, P. L.
Low, J. R.
Lynn, Saml.
Marshall, W. T.

Mason, Stephen C.
Maxfield, H. H.
Mitchell, A. G.
Mitchell, J. W.
Miyaski, Y.
Montague, W. T.
McFarland, H. L.
McKinstry, C. H.
McNaight, A. H.
Neel, T. M.
Newbury, E. H.
Painter, Jos.
Pattison, J. E.
Pearson, A.
Pehrson, A. K.
Pennington, F. W.
Pfeil, John
Pie, J. J.
Postlethwaite, C. E.
Ralston, J. A.
Rea, C. S.
Redding, D. J.
Reynolds, Thos. A.
Rhodes, E. M.
Richardson, L.
Richers, G. J.
Ridley, R. C.
Robbins, J. A.
Roemer, W.
Runser, K. W.
Ryder, G. E.
Schaich, W. L.
Schroedel, A. H.
Searles, E. J.
Sewell, H. B.
Slutzker, Jos.
Smead, D. N.
Smoot, W. D.
Snyder, J. Rush
Stamets, W. K.
Stevens, C. W.
Stark, F. H.
Stucki, A.
Suckfield, G. A.
Swann, J. B.
Thomas, J. H.
Trappe, W. C.
Tucker, J. L.
Wahlert, H. A.
Walther, G. C.
Wardale, N. H.
Warne, J. C.
Warnock, H. R.
Watkins, G. H.
Way, L. A.
White, F. L.
Williamson, J. A.
Wood, R. C.
Wyke, J. W.

VISITORS.

Andrews, J. P.
Armstrong, L. N.
Booker, George
Burson, H. A.
Cock, Robert B.
Code, C. J.
Coulter, F. C.
Dewire, E. G.
Dillon, S.
Ewalt, Wm.
Ferree, H. N.
Forsyth, W. D.
Freygang, A. H.
Gilles, R. T.
Harsch, A. M.
Huchel, W. J.
Jones, L. E.
Karger, R. F.
King, Cal. C.
King, S. A. Jr.
Larson, W. E.
Lewis, R. A.
Maclean, M. R.
Marcus, M.
Miles, C. B.
Minon, L. L.
Moorhead, G. O.
Morgan, D. G.
McCahan, J. E.
Rauterkus, J. A.
Redding, R.
Robinson, S. R.

Sandhas, H. L.	Wagner, E. A.
Schaffint, W. E.	Way, E. S.
Shaner, E. L.	Weaver, C. H.
Smith, A. C.	Weaver, E. H.
Smith, H. B.	Welten, S. A.
Sneck, H.	Wiese, A. J.
Stenson, G. A.	Wenell, Karl

VICE-PRESIDENT CODE: Gentlemen, our President is detained by illness in his family, and in his absence you will have to do the best you can with a substitute.

A record of attendance being had from the registration cards, the call of the roll will be dispensed with.

The minutes of the last meeting being in the hands of the printer, the reading of the same will be dispensed with and the minutes as published will be approved, if there are no objection. Hearing no objections, it is so ordered.

The Secretary read the following applications for membership:

Braun Otto, Assistant Foreman Machine Shop, P. & L. E. R. R., McKees Rocks, Pa. Recommended by J. A. Williamson.

Dillon, Stewart, Chief Chemist, Vulcan Oil Refining Co., Coraopolis, Pa. Recommended by J. R. Low.

Emmett, W. A., Tool Dresser, Pennsylvania Lines West, 3012 Perrysville Avenue, N. S., Pittsburgh, Pa. Recommended by Gilbert E. Sarver.

Ewald, Wm., Supt. M. P., Cumberland & Pittsburgh R. R., Mt. Savage, Md. Recommended by H. R. Warnock.

Forsyth, W. D., Vice President, Railway Products Corporation, Buffalo, N. Y. Recommended by D. H. Amsbary.

Freygang, A. H., District Bridge Inspector, B. & O. R. R., Room 22 B. & O. Terminal, Pittsburgh, Pa. Recommended by E. M. Rhodes.

Harsch, A. M., Clerk, General Store Keepers Office, P. & L. E. R. R., McKees Rocks, Pa. Recommended by J. A. Williamson.

Hermanson, Theo. H., Supt. Epping & Carpenter Pump Co.,

114 South Negley Avenue, Pittsburgh, Pa. Recommended by J. B. Anderson.

Kelly, H. S., Assistant Store-Keeper, P. & L. E. R. R., McKees Rocks, Pa. Recommended by J. A. Williamson.

Lawley, R. N., Draftsman, Westinghouse Air Brake Co., 902 Jancey Street, Pittsburgh, Pa. Recommended by P. L. Lobez.

Milligan, E. E., Inspector, W. P. Ter. R. R., 790 West Carson Street, Pittsburgh, Pa. Recommended by C. O. Dambach.

Morse, L. A., Foreman Painters, Pennsylvania R. R., Pitcairn, Pa. Recommended by J. B. Anderson.

Neill, Jess, Clerk, Pennsylvania Lines West, 1017 Pennsylvania Station, Pittsburgh, Pa. Recommended by J. O. Caldwell.

Niemeyer, F. C., Blacksmith, Pennsylvania R. R., 12 Lakewood Avenue, West View, Pa. Recommended by G. E. Sarver.

Way, E. S., General Foreman, M. C. B. Clearing House, Penna. R. R., Altoona, Pa. Recommended by R. L. Kleine.

Wiese, A. J., General Car Foreman, B. & O. R. R., 1481 Dormont Avenue, Dormont, Pittsburgh, Pa. Recommended by S. A. Cromwell.

PRESIDENT: As soon as these applicants have been favorably passed upon by the Executive Committee they will become members without further action.

Have any of the members anything to offer in the way of new business?

FULL CREW LAW.

MR. D. M. HOWE: Mr. President, I would like to offer the following resolution for consideration of the Club:

"WHEREAS, There have been incorporated in the statutes of the State of Pennsylvania, certain laws generally known as "Full Crew Laws" which require the employment upon trains

of men in excess of the number to which any useful service in connection with train operation can be assigned, and,

WHEREAS, The enactment of such laws has been generally urged upon legislators as a measure of safety, such representations are made and supported only by those whose actual interest lies in the employment of a greater number of their fellows, regardless of usefulness or safety considerations, and,

WHEREAS, The employment in train operation of men in excess of needs instead of promoting safety tends rather to increase danger by dividing responsibility and cultivating habits of carelessness. Therefore be it,

RESOLVED: That the large amounts expended by Railroad Companies for extra men to comply with such laws constitute a waste of revenue, unnecessary, unjustifiable, and against enlightened public policy which demands and requires conservation of the country's resources and approves pay roll representation only for such as render service. Whether the pay roll be that of a railroad, a bank, store, mill or a farm, compulsory employment of surplus labor is an unwarranted tax upon the whole people for the benefit of a special class, and, further,

RESOLVED: That The Railway Club of Pittsburgh, at a regular meeting on February 26th, 1915, emphatically endorses the appeals now being made to the representatives of the people for the repeal of such legislation.

BE IT FURTHER RESOLVED: That a copy of this resolution be forwarded to the Governor of the State of Pennsylvania and to each member of the Legislature from Allegheny County and to each member of the Senate and House Committee on railroads."

MR. HOWE: Mr. President, I move you that these resolutions be adopted as read.

MR. STEPHEN C. MASON: Mr. President, I second the motion made by Mr. Howe for the reason that I believe we all think this action is for the best interest of all concerned.

MR. A. STUCKI: Mr. President, it strikes me from a general point of view and especially from the viewpoint of economy that this motion is entirely in order. I have been connected with manufacturing concerns for many years and the main aim always was and always must be to economize. Special

machinery has been designed for such purposes and changes have often been made in shop plants and their arrangements with a view of reducing labor in handling material and it looks to me that the Railroads right along try to do the same thing. You have improved the brakes, the signals and a great many details, so as to reduce labor and make them more safe and the couplers are even perfected to such an extent that the men do not have to go between the cars at all, but instead of reducing labor, under some of the existing laws, you are compelled to hire more. This is absolutely wrong. We should not waste labor unnecessarily, and with that point in view I am certainly in full harmony with the resolution just introduced.

MR. FRANK J. LANAHAN: I think Mr. Stucki has hit the point, therefore I call for the question on the motion.

PRESIDENT: Gentlemen, you have heard this resolution and the motion made for its adoption. Are there any further remarks? Hearing none, those in favor of the adoption of this resolution will give their consent by saying, aye. Those opposed, no. The resolution is adopted unanimously.

SECRETARY: Mr. President, in connection with this subject I would like to read a copy of a resolution adopted by the New York Railroad Club at their regular meeting held February 19th, 1915, as follows:

"Resolved, that the bills being introduced in the State Legislature of Pennsylvania, New Jersey and New York, repealing the full crew laws now in force in these states, has the approval of the New York Railroad Club and that the members of the Club pledge themselves that they will personally use their influence to educate the voters of their respective states, that the claims of the railroads are right and just and that they will use their persuasion to have the question brought to the attention of members of the legislatures and Senators of the States before mentioned.

Resolved, That the Secretary send a copy of this resolution to all Railroad Clubs."

PRESIDENT: If there is no further business, the paper of the evening, on the subject, "Some Experiments to Determine Forces on a Truck Side Frame, and Stresses Produced by These

Forces," will be presented by Professor Louis E. Endsley, of the University of Pittsburgh. We are fortunate, and proud of the fact, that our great University is working in such close co-operation with the practical side of the subject to produce results. The speaker is not a stranger to us. His voice and presence are familiar at our meetings, and no introduction on my part is necessary. I would say just a word of caution. Whatever theories the Professor may propound, or to whatever conclusions he may jump, unless they are fully supported by facts it may be wise to suspend judgment until we have heard from our globe-trotting member (Mr. Stucki) of the unique accent.

PROFESSOR LOUIS E. ENDSLEY: Mr. President and Gentlemen of The Railway Club of Pittsburgh:—I am very glad to be here tonight, and as I have the first and last word, Mr. Stucki will have to keep watch.

SOME EXPERIMENTS TO DETERMINE THE FORCE ON A TRUCK SIDE FRAME AND THE STRESSES PRODUCED BY THESE FORCES.

By Prof. Louis E. Endsley, University of Pittsburgh.

Introduction.

The design of the different members of a freight car truck for a good many years, has received careful attention, but so far as the writer knows, no definite information had ever been obtained with regard to the actual force coming on the side frame until the work herein described, was undertaken.

The object of these experiments was to obtain the actual force coming on the truck side frame and from the force thus obtained, to check some test on a truck side frame in which the writer has assumed certain forces.

The three main forces to which the side frame is subject, are, the downward spring pressure, the end thrust of the bolster, and the twisting of the side frame which the spring plank gives it when the car is on a curve and the inside pair of wheels are attempting to get ahead of the outside pair of wheels. Of

FIG.1,

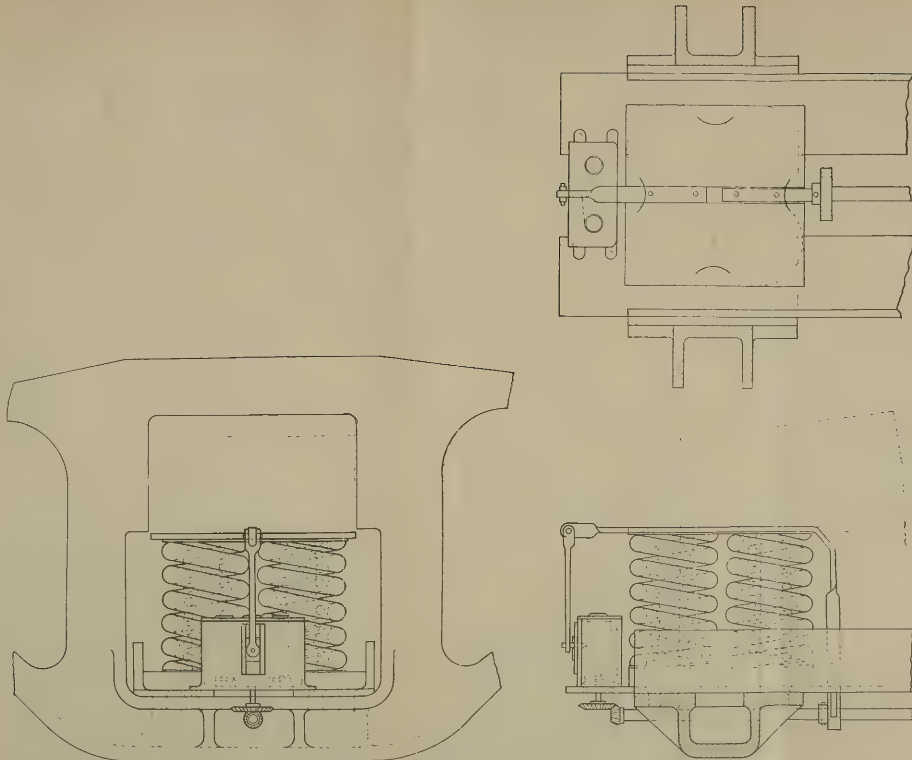


FIG.I, SHOWING APPARATUS USED TO DETEMINE THE MAXIMUM DIRECT VERTICAL LOAD.

the three forces just mentioned, the maximum direct vertical force had often been estimated and was generally considered to be not over twice the normal load on the frame when the car was standing still. That is, the vibration of the car up and down on its spring might carry the pressure underneath the spring from almost nothing to double the normal load.

Some years ago, experiments were conducted by placing in the center of the spring, a short block of wood in which a nail was driven, and as the car body moved up and down, the upper spring cap would drive the nail deeper and deeper into the wood, and from this the total compression of the springs was obtained. But so far as the bolster pressure against the side frame and the twist of the spring planks, nothing in the writer's knowledge had ever been attempted.

Apparatus Used to Determine Force on Side Frame.

The car used in the test was a Pennsylvania standard H 21 hopper, which had special cast steel trucks under it. One truck was designed to obtain the direct vertical load, and the other to obtain the bolster thrust and the twist of the spring plank.

The apparatus used to determine the maximum direct vertical load, one end of which is shown in Fig. 1, consisted of two new sets of standard M. C. B. coil springs, which were calibrated. Two special spring caps were used. An arm extended inward from each spring cap carrying a ratchet which revolved a shaft that extended across the truck. These ratchets were so designed that as the spring cap moved up and down the shaft would revolve in one direction. An arm, also extending outward, carrying a vertical link which was connected to a slide in which a horizontal pencil was held. The slide moved up and down in a small box that contained three vertical cylinders, which carried a scroll of paper. These three cylinders were so geared to the shaft running across the truck that the paper was unwound from No. 1 cylinder, wound up on No. 3 cylinder, and passed almost one-fourth the way around No. 2 cylinder. As the axis of the cylinders were all vertical, and the paper moved around the cylinder, the pencil would make a sawtooth mark on the paper. In this way the exact movement of the spring cap up and down was obtained. Fig. 2 shows a typical record. It will be seen that the distance between any

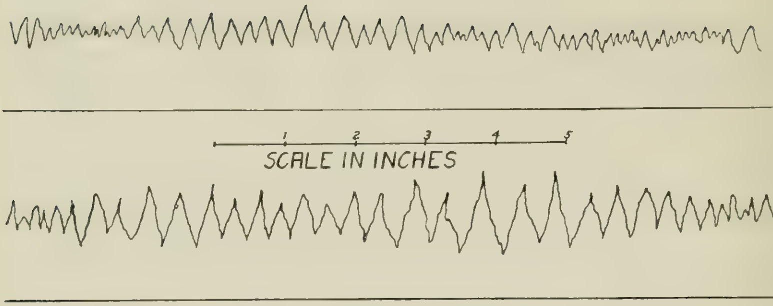


FIG 2, SHOWING TYPICAL RECORD MADE ON THE PAPER TO DETERMINE DIRECT VERTICAL LOAD ON SIDE FRAME

two sawtooth was equal to about one-fourth the total movement up and down. In order that the record on the two sides of the truck could be connected, the No. 2 cylinder on each side had a small point sticking up that pricked a hole in the paper every time the cylinders made one revolution. As the gearing was so constructed that the No. 2 cylinder on each side made the same number of revolutions, it only remained to make a reference mark at the beginning of each scroll of paper to connect the record on each side.

The apparatus used in getting the thrust of the bolster consisted of a specially constructed bolster, shown in Fig. 3, which had a solid web cast across it at A, on each side of which was a calibrated spring which were placed under an initial compression of about one-half their capacity by tightening the bolt B running through what might be called the spring heads C and C. Connected firmly to the spring head were two rods, shown in Fig. 3, at D and D, and extending to each end of the bolster. These rods, D and D, were threaded and passed through two striking blocks, E and E. The striking blocks served as the lugs on the ordinary bolster, but in this case they were only on the inside of the frame. These striking blocks were held from moving across the bolster by the end of rods D and D passing through a bushing in the end of the bolster, and any movement of these blocks endwise of the bolster, would be resisted by the springs. That is, any movement of the right hand block inward would compress the right hand spring and release the left hand spring, and any movement of the left hand block inward would have the opposite effect on the springs. In

FIG. 3. S

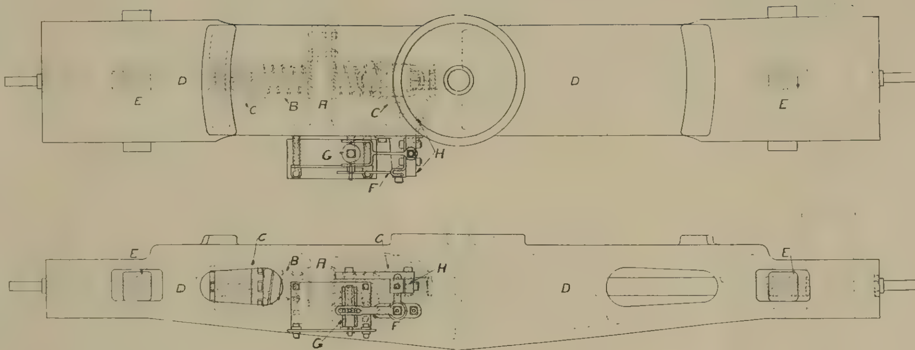


FIG. 3. SHOWING SPECIAL BOLSTER AND RECORDING MECHANISM USED IN DETERMINING THE BOLSTER THRUST ON THE SIDE FRAME

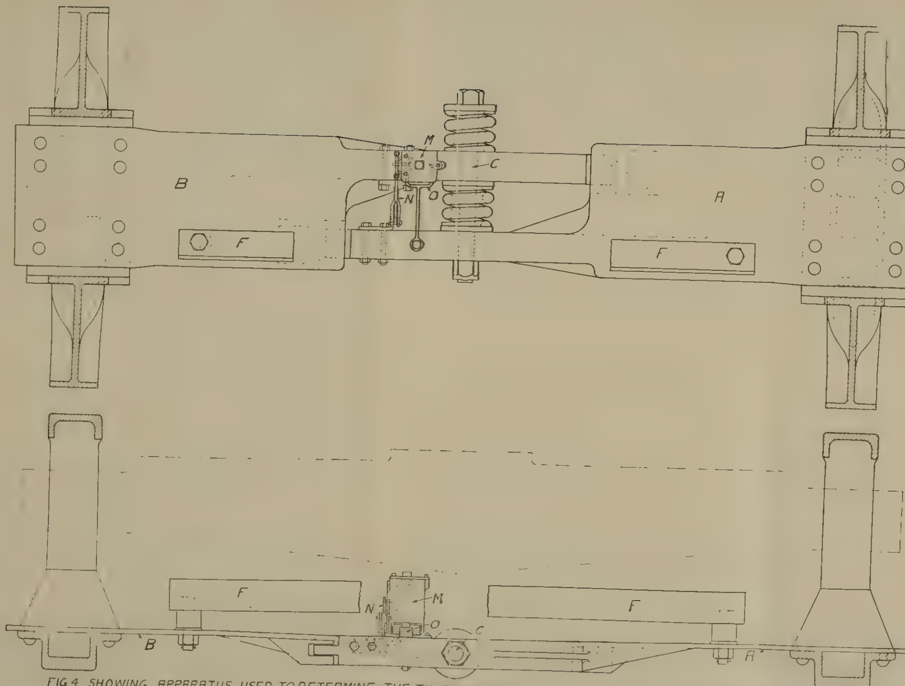


FIG 4. SHOWING APPARATUS USED TO DETERMINE THE TWISTING FORCE OF THE SPRING PLANK COMING ON THE SIDE FRAME.

this way the force exerted on either block for any given movement, would be equal to twice the calibration of one spring for this movement. So by knowing the initial pressure on each spring (which must be equal with no force on either block) and the calibration of each spring and the movement due to any force on the block, the exact force was obtained from the calibration curves of the springs. It so happened that the two springs were identical. The movement of the spring head with regard to the bolster was obtained by recording the movement of the arm H, which was fastened to one spring head and extended out through a slot in the side of the bolster. This movement was recorded on the copper drum G, by means of a bell-crank F, which moved a steel point up and down the drum. The drum was caused to revolve by means of a ratchet connected to the base of the drum and the arm H. In this way any force on the blocks would cause arm H to move with respect to the bolster, and as the drum G was mounted on the bolster, the steel point would move up and down, and the ratchet would revolve the drum, thus making a sawtooth record on the drum, and from this record the maximum force was obtained.

The apparatus shown in Fig. 4, was used to obtain the force on the side frame due to the twist of the spring plank. It consisted of a spring plank made up of two similar shaped castings, A and B, which were fastened to the side frames by eight (8) machine taper bolts. These two castings were held together by a bolt C, that extended through holes in the casting and held two springs, one between the two parts, A and B, and one on the outside of B. This bolt had an initial tension of approximately one-half the capacity of the springs. In order to space the two side frames the correct distance apart so that the bolt in the center would not bind, the angle F was bolted to the two pieces.

The recording arrangement was very similar to that just described for the bolster. It consists of the drum M, the bell-crank N, and the ratchet O.

Methods of Testing to Obtain Forces on Truck Side Frame.

After the car was equipped, as already described, it was first tested light, by putting it next to a switch engine in the Allegheny yards of the Pennsylvania Railroad. This was done

in order that minor adjustment of the apparatus might be made and the whole thing tried out. After which the car was put in a local freight train and repeated round trips from Pittsburgh to Alliance were made. The test with the car in the local freight train was conducted with the car running light, 48,700 pounds, 66,000 pound load, 91,000 pound and 119,150 pound load, making the total loads as tested 48.700, 114,700, 139,700 and 167,850 pounds. After this the car was put in fast freight service between Pittsburgh and Alliance with a load of 91,000 pounds in the car, a total of 139,700 pounds. All of the tests were conducted between the Allegheny shops and Alliance, except one round trip which was made with 91,000 pounds in the car between Pittsburgh and Altoona in fast freight service to obtain the force due the twisting action of the spring plank.

Results Obtained.

Table No. 1 gives the results obtained with regard to the maximum direct vertical force on the side frame.

Table No. 1. Giving Results of Tests to Determine Maximum Vertical Pressure Coming on Truck Side Frame.

Test I	Kind at Service II	Load on Car III	Load on Truck Side Frame Normal IV	Maximum Pressure on Side-Frame Lbs. V	Maximum Load in Per Cent. Normal VI
1	Local	None	8175	16400	200
2	"	None	8175	15800	193
3	"	66000	24675	52800	214
4	"	66000	24675	45000	182
5	Through Freight	91000	30925	66600	216
6	"	91000	30925	76000	246
7	"	91000	30925	60000	194

The first three columns are self-explanatory. Column No. IV gives load in pounds on the side frame with the car standing still. These values were obtained by subtracting the weight of the wheels, axles, side frames and journal boxes from the total weight of the car, and dividing the remainder by four. Column No. V gives the maximum pressure obtained of the direct vertical load. This was obtained from the record made of the maximum compressing of the springs as recorded on the paper in the boxes at each end of the spring plank.

The first four values in this column were obtained while

Table No. II. Giving Results of Tests to Determine Maximum Bolster Thurst Coming on Truck Side Frame.

Test	Kind of Service	Load on Car	Load on Truck Side Frame Normal	Bolster Thrust in Lbs. on Side Frame Maximum Right	Left	Bolster Thrust in Per Cent. of Normal Load on Side Frame Right	Left
I	II	III	IV	V	VI	VII	VIII
1	Local	None	8175	4300	4600	52.6	56.2
2	"	66000	24675	5900	9200	24.0	37.4
3	"	119150	38463	5900	9500	15.4	25.4
4	"	91000	30925	8500	7500	27.4	24.2
5	"	91000	30925	5400	5300	17.4	17.2
6	"	91000	30925	4000	5100	13.0	16.5
7	Through Fast Freight	91000	30925	4900	7500	15.8	24.2
8	"	91000	30925	7300	7300	23.6	23.6

Each Test Represents a Round Trip, Pittsburgh to Alliance.

the car was equipped with M. C. B. standard 100,000 pounds capacity springs, each of which has a capacity of 64,000 pounds before going solid, while the last three values were obtained with special springs, each having a capacity of 104,000 pounds before going solid.

Column No. VI gives the total load in percent. of the normal, and was obtained by dividing the values in column No. V by those in column No. IV.

Table No. II gives the results obtained with regard to the maximum pressure set up between the bolster and side frame, due to the end thrust of the bolster against the columns of the frame. The first four columns of the table are the same as those of table No. I. Column No. V gives the maximum pressure between the right side frame and the right striking block; column No. VI gives the maximum pressure between the left side frame and the left striking block; columns VII and VIII gives the maximum pressure in percent. of the normal load obtained by dividing columns V and VI (respectively) by column No. IV.

Table No. III. Giving Results of Tests to Determine Maximum Twisting Force Coming on Truck Side Frame.

Test	Kind of Service	Load in Car	Load on Truck Side Frame Normal	Twisting of Spring Plank in Lbs. at Center of Truck Maximum	Twisting Load in Per Cent of Normal Load on Side Frame
I	II	III	IV	V	VI
1	Local	None	8175	3000	36.7
2	"	66000	24675	3975	16.1
3	"	119150	38463	4975	12.8
4	"	91000	30925	5050	16.3
5	"	91000	30925	5050	16.3
6	Through Fast Freight	91000	30925	5550	18.0
7	"	91000	30925	6100	19.6

First six tests represent trips from Pittsburgh to Alliance and return. No. 7 test represents trip from Pittsburgh to Altoona and return.

Table III gives the results obtained with regard to the maximum force due to the twisting action of the spring plank on the frame. The first four columns are the same as those in the two former tables; column V shows the maximum force due to the twisting action of the spring plank on the frame obtained at a leverage of half the width of the truck; column

VI gives the twisting load in percent. of the normal load on the frame as obtained by dividing columns V by column IV.

Maximum Forces Coming on Truck.

From a survey of the results obtained in Table No. 1, it will be seen that the maximum direct vertical pressure will vary from 182 percent. to 246 percent. of the normal load on the frame. The results, however, show that only in one case does the maximum load exceed 216 percent. of the normal load, so that for the design of a freight car truck probably a conservative figure would be 220 percent. of the normal load on the frame.

We found, however, during three round trips tests between Pittsburgh and Alliance, in which the standard M. C. B. springs were under the car and the total weight of the car was 139,700 pounds, that the springs went solid several times during each trip of eighty (80) miles. This would indicate that a force of over 64,000 pounds, which was the capacity of the springs, came upon the springs.

After it became evident that these springs were going solid, the car was equipped with four new sets of springs, each having a capacity of 104,000 pounds, and three round trips were made, the results of which are given as the last three lines in column V of Table No. 1. These results would indicate very clearly that the standard M. C. B. springs do not have high enough capacity, that forces of over 70,000 pounds were not unusual with a normal load of 30,925 pounds on the frame. Now if we consider for the average 100,000 pound car, weighing 40,000 pounds and loaded to 110,000 pound capacity, making a total weight of 150,000 pounds, that the wheels, axles, side frames and journal boxes are not carried by the springs, the normal load carried by each spring would approximate 33,000 pounds. If we consider that 220 per cent of this load—the maximum force for design would be 72,600 pounds for each frame. This is somewhat higher than most companies have used in their design—68,500 pounds being a common figure. Then in view of the fact that the springs are going solid, it is almost impossible to predict what maximum force might be obtained due to the impact after the springs go solid. This fact may account

for a great many of our failures in arch bar and cast steel side frames.

From a study of Table No. II, it will be seen that the force obtained due to the end thrust of the bolster against the columns of the frame, referred to hereafter as the transverse load on the frame, varied considerably—but the maximum with the total weight of the car of 167,850 pounds, was 9,500 pounds or 25.4 per cent. of the normal load on the side frame. This 25.4 per cent. of the average load on a side frame on a hundred thousand pound capacity car would be about 8,500 pounds, and probably for safe figuring, 9,000 pounds would be the maximum force for test purposes.

From Table No. III it will be seen that the twisting force reached a maximum in the trip from Pittsburgh to Altoona and as this force is dependent upon the degrees of curvature, this is readily explained as this track has one or two curves of eight (8) degrees curvature, and the track between Pittsburgh and Alliance has no curve of over six (6) degrees. The maximum force obtained was 6,100 pounds from which we may assume that 6,000 pounds would probably be a safe figure for test.

Force Used in Test of Side Frame.

The last part of this paper which deals with the actual stress in the side frame, is taken from the results obtained from the tests of some forty (40) different designs of side frames, using three forces acting on the frame as described above. The exact amounts of the three forces were not the same as those found in actual service, due to the fact that the tests conducted to determine the stress set up in the side frame were made before the tests to determine the actual maximum force, were carried out. And for the purpose of this paper only the complete results from two different designs of frame will be included.

As has been previously given in the report the three forces, namely, direct vertical, transverse and twisting, were found to have maximum values for a hundred thousand pound car of approximately 72,000 pounds, 9,000 pounds and 6,000 pounds, respectively. The actual forces used in the testing hereafter described were 68,500 pounds direct vertical—6,000 pounds

transverse and 5,000 pounds twisting. However, in the tables hereafter described, the results due to the transverse load have been increased 50 per cent. and represent the stress due to a transverse load of 9,000 pounds. There might be some question in this procedure, if it had not already been found in actual test that for all practical purposes the stress at any point in the frame was directly proportioned to the loads as long as the elastic limit of the metal was not reached.

Method of Testing to Determine Stresses.

For the purpose of determining the stress throughout the frame under the three different loads, namely, direct vertical, transverse and twisting, the Berry Strain Gage was used. These gages are so constructed that the elongation in a two inch gage length can be determined to .0002 of an inch. A photograph of this gage is shown in Fig. 5.

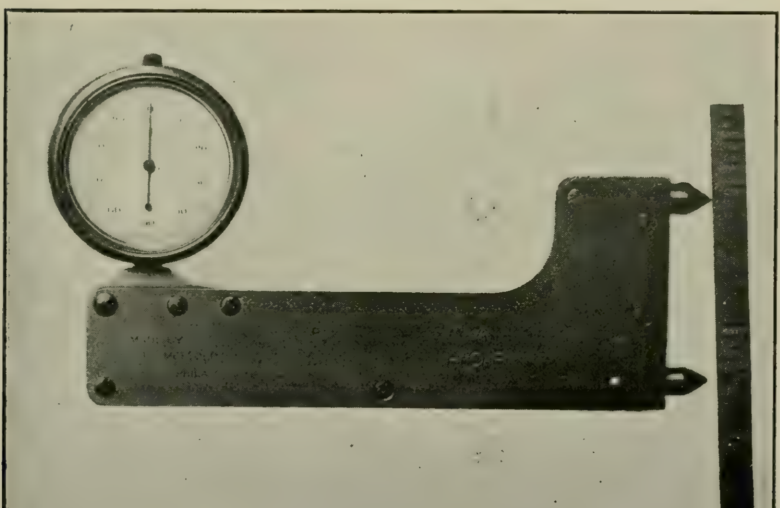


Fig. 5 Showing Berry Strain Gauge.

It will be seen that the dial of the instrument is divided into 100 parts. The movement of the hand over each of these divisions, which is approximately one-sixteenth of an inch, is equivalent for the cast steel used in these tests to a stress of

2700 pounds per square inch. This 2700 value was arrived at by determining the modulus of elasticity of the steel which from several tests was found to be approximately 27,000,000.

I will say that this instrument is a delicate machine and it requires some patience and skill to operate. A common day laborer could not obtain accurate results.

In preparation for a test the frame was mounted as shown in Fig. 6 and 7, on two heavy supporting castings on the bed plate of the testing machine. The machine used was a 300,000 pound Riehle Testing Machine, located at the Granite City Plant of the American Steel Foundries. The distance between the support was equal to the wheel base of the truck. Double knife edge bearings over the supports were used. Cap castings over the support and filler blocks were also used to obtain the correct height for the spring seat and to support the knife edges. Any irregularities on the bearing surfaces of the frames were taken up by the use of half inch soft wooden blocks between the top filler blocks and the frames. The direct vertical load was applied through the casting A, (which was bolted to the

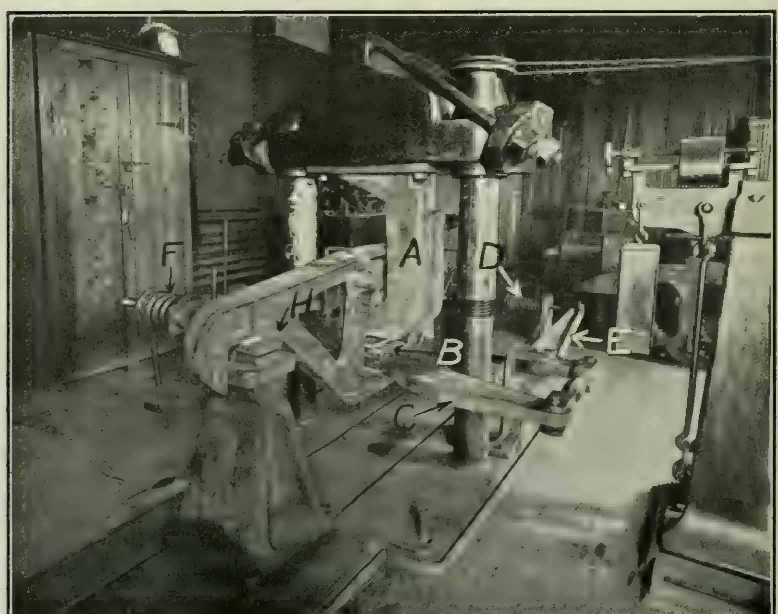


Fig. 6. Showing Method of Mounting Frame.

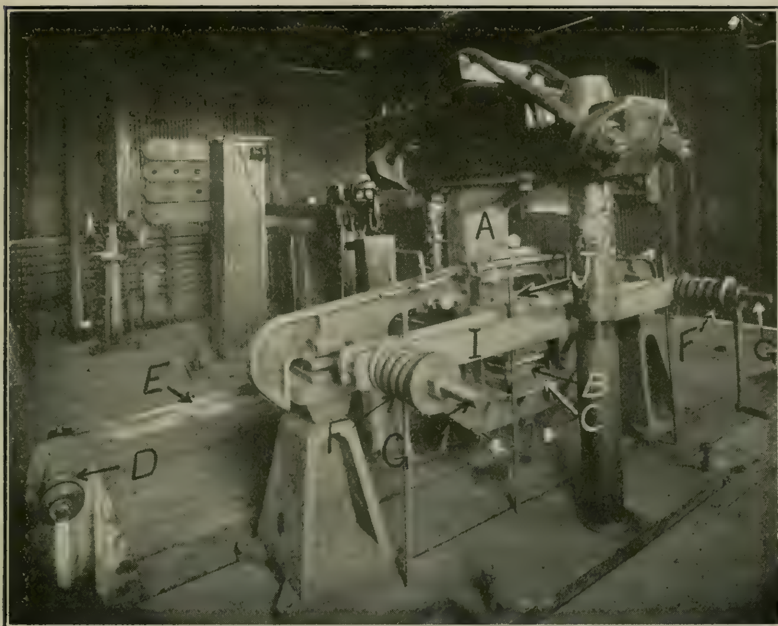


Fig. 7. Showing Method of Mounting Frame.

head of the testing machine as shown in the figures) to a one inch by three-eighth inch by ten inch strip lying over the center line of the spring seat. It was then transmitted through a 1 inch by 3 inch by 8 inch filler block to the circular ball bearing B, which rested on the steel casting C, used to take the place of the spring plank in the tests. Wooden blocks were used above and below the ball bearings to take up any irregularities on the surface of the casting or in loading. A special spring plank casting was placed on the spring seat and a load was transmitted through it to the spring seat. The thickness of this special spring plank underneath the ball bearing was one-half inch. The twisting load was applied through this special designed spring plank casting C, which was bolted to the side frame by eight ¾ inch bolts. The load was applied to the calibrated spring D, and was transmitted through the lever casting E, to the spring plank casting. After the vertical load was applied, any desired twisting load could be applied without danger of moving the side frame upon its support.

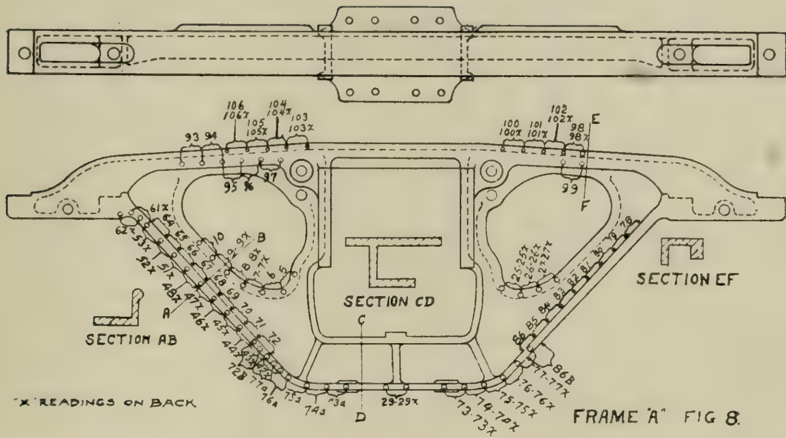
The transverse load was obtained by applying a load to the calibrated springs F, which were anchored to the frame by means of bolts G, castings H, which hooked under the edge of the journal box seat, through the casting I, and column casting J to the columns. After the frame had been selected for the test, the points of reading were located, and small holes were drilled with a No. 56 drill, into the casting about ⅛ inch deep, exactly 2 inches apart, and these holes were then reamed to get a good firm surface for the points of the instruments to rest in. The frame was then mounted in the testing machine, as already described. As we had several instruments they were clamped at different positions around the frame where the readings were desired, and 5,000 pounds vertical load was applied to the frame. A zero reading of all instruments was then taken, after which the direct vertical load was increased to 73,500 pounds and the instruments were all read again. A twisting load equivalent to 5,000 pounds was applied to the center of the spring plank and another reading of each instrument was taken, after which a 6,000 pound transverse load was applied to the calibrated springs F and F, and a fourth reading of the instruments was taken. From these four readings taken, the stresses equivalent to each of the loads at any point was determined by repeating the above tests until all points where readings were desired, had been covered.

Description of Frame Used in This Paper.

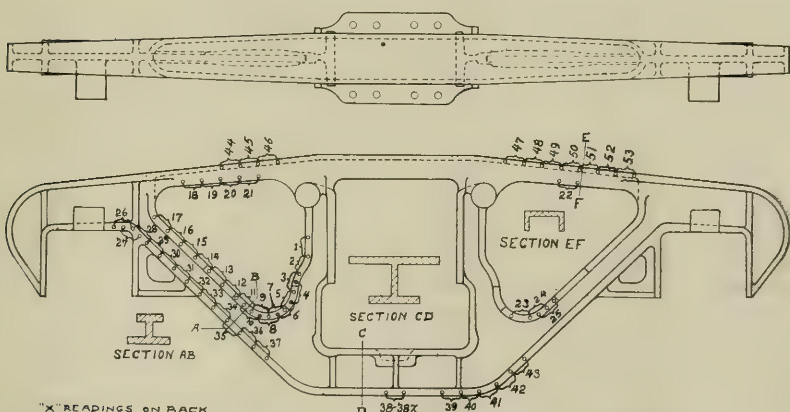
The two frames which will be discussed in this paper were from two general types of design, designated according to the cross section of the different members in the frames, namely, the "L" section and the "I" section. The "L" section type is as shown in Fig. 8 and will for this paper be referred to hereafter as frame A. This design of frame has been discarded by the manufacturers.

The "I" section type, as shown in Fig. 9, is a later type of design and will hereafter be referred to as frame B.

Several changes in the B type of frame were made as the tests progressed. For instance it was soon found that a B type of frame with the ordinary bead around the inside of the triangular opening was apparently weak at points 11 and 25, so that frames of this type having different width beads from



FRAME "A" FIG 8.



FRAME "B" FIG. 9.

points 4 around to 15 were made. Also it was found that the width of the bottom flange had a considerable effect upon the stress obtained, due to the twisting force of the spring plank, so that frames having different widths of bottom members were tested.

Results Obtained.

Table IV gives the results obtained from the tests made on the A frames under the three loads as described above. The weight of the frame as tested was 402 pounds. Column No. 1

Table IV. Showing Stresses Obtained From Cast Steel Side Frame A.

Position No.	Stress for 68500 Lbs. Vertical Load	Stress for 5000 Lbs. Twisting Load	Stress for 9000 Lbs. Transverse Load	Maximum Stress
I	II	III	IV	V
5	—5400	None	None	—5400
6	9700	1100	None	10800
7	20200	—1400	800	21000
7x	6500	—3000	1600	8100
8	16500	—2200	1600	18100
8x	5400	—2700	None	5400
9	10000	—2200	2400	12400
9x	4600	—1900	None	4600
10	6200	—800	None	6200
25	8100	—1600	—500	8100
25x	—2200	—3800	None	—6000
26	21200	1900	1100	24200
26x	5700	4000	2200	11900
27	24500	3500	800	28800
27x	5400	5700	3200	14300
29	—2700	None	—4000	—6700
29x	27000	None	2400	29400
42x	None	—500	None	—500
43x	—300	—6200	2000	—6500
44x	500	—5900	800	—5400
45x	—1600	—3500	None	—5100
46x	—2700	—3500	—1600	—7800
47x	500	—2400	—1200	—3100
48x	5400	—1400	—1200	5400
51x	10500	—1100	—1200	10500
52x	11900	—500	—800	11900
53x	18100	None	—1200	18100
61x	20000	None	—2000	20000
62x	19500	—500	—800	19500
64	—11300	—800	3200	—12100
65	3200	None	2000	5200
66	—500	1700	2800	—3700
67	14300	3500	800	18600
68	19500	5700	None	25200
69	17600	5100	—800	22700
70	18100	8400	—2800	26500
71	17800	9200	—3200	27000
72	21900	16200	—6500	38100
72b	13200	10500	—3200	23700
73	—15700	—11900	—8400	—36000
73x	8100	5400	1200	14700
73a	11900	8900	—6000	20800
74	7600	—9700	—4000	7600
74x	2700	6800	2000	11500
74a	10800	13500	—5200	24300
75	4900	—4300	—1200	4900
75x	2400	7300	1600	11300
75a	5100	5100	—1600	10200
76	13000	—15400	—4400	13000
76x	None	6800	1600	8400
76a	12200	11100	—4400	23300
77	13200	—11300	—4800	13200

Minus = Compression.

Table IV. Showing Stresses Obtained From Cast Steel Side Frame A.—(Continued)

Position No.	Stress for 68500 Lbs. Vertical Load	Stress for 5000 Lbs. Twisting Load	Stress for 9000 Lbs. Transverse Load	Maximum Stress
I	II	III	IV	V
77x	800	6200	1600	8600
77a	15900	15100	—4000	31000
78	—1400	500	2800	1900
79	3800	—300	2000	5800
80	10000	—1400	1600	11600
81	15400	—2700	800	16200
82	17600	—5400	None	17600
83	17800	—6800	—800	17800
84	18100	—8400	—3200	18100
85	15400	—9700	—2400	15400
86	19000	—13300	—5600	19000
86b	10800	—9500	—4000	10800
93	—300	1900	—4400	—4700
94	—1100	1400	—5200	—6300
95	—800	1400	—4800	—5600
96	—1400	1400	—6800	—8200
97	—500	1400	—6000	—6500
98	—3800	—1600	—4800	—10200
98x	—10300	1600	3200	—10300
99	—1100	—2200	—4000	—7300
100	—3500	—1600	—4400	—9500
100x	—8600	1400	3600	—8600
101	—4000	—1900	—4000	—9900
101x	—11100	800	4800	—11100
102	—4000	—1900	—5200	—11100
102x	—10500	1600	5200	—10500
103	—4000	1400	—4800	—8800
103x	—11300	—800	4000	—12100
104	—5400	1400	—4400	—9800
104x	—9700	—800	3200	—10500
105	—2700	500	—4800	—7500
105x	—11300	—1600	6000	—12900
106	—4300	1600	—7200	—11500
106x	—11600	—500	6000	—12100

Minus = Compression.

gives the position of reading on the frame and the numbers in the table correspond to the number in Fig. 8. It will be seen that some numbers are omitted, which is due to the fact that only points of maximum stress or especial significance are considered in this paper.

Column II gives the stress under a vertical load of 68,500 pounds. The negative signs in the table represent compression.

Column III gives the stress for a 5,000 pound twisting force applied for the side frame at a distance equal to half the width of the truck.

Column IV gives the stress corresponding to a transverse load of 9,000 pounds.

Column V gives the maximum calculated stress at the different positions on the frame under the direct vertical, twisting, and transverse loads.

In determining this column of maximum stress due to the direct vertical, twisting and transverse loads the following assumptions were made:

(1) That a full direct vertical load as used was always acting.

(2) That the stresses due to twisting and transverse loads, would add to or subtract from the stresses due to the vertical.

(3) That either one, or both, the transverse or twisting loads might be acting or dormant.

Table V. Showing Stresses Obtained From Cast Steel Side Frame B.

Position No.	Stress for 68500 Lbs. Vertical Load	Stress for 5000 Lbs. Twisting Load	Stress for 9000 Lbs. Transverse Load	Maximum Stress
I	II	III	IV	V
1	—1100	1400	....	....
2	—4500	2400	....	....
3	—7300	2700	....	....
4	—8900	2400	....	....
5	—9500	3500	....	....
6	—7600	3800	....	....
7	—3500	3000	—1700	—5200
8	1100	4000	—2100	5100
9	8100	1900	—1200	10000
10	11100	2200	—1200	13300
11	11600	2200	—800	13800
11x	10800	—1900	—600	10800
12	11600	2700	—800	14300
13	11100	—1900	....	....
14	10800	2400	....	....
15	9200	1400	....	....
16	8600	800	....	....
17	4600	800	....	....
17	—8400	500	—4800	—13200
19	—5400	1600	—6000	—11400
20	—4600	1100	—7300	—11900
21	—2700	1600	—6900	—9600
22	—3500	—2200	—8900	—14600
23	3200	—1600	—2100	3200
24	7800	—1600	—1700	7800
25	9700	—2200	None	9700
26	8600	—2200	....	....
27	11900	—4600	....	....

Minus = Compression.

Table V. Showing Stresses Obtained From Cast Steel Side Frame B.—(Continued)

Position No.	Stress for 68500 Lbs. Vertical Load	Stress for 5000 Lbs. Twisting Load	Stress for 9000 Lbs. Transverse Load	Maximum Stress
I	II	III	IV	V
28	6500	—1400	....	....
29x	8900	None	—7000	8900
30	7600	3000	2100	12700
30x	9200	—1100	—3300	9200
31	6800	2200	2800	11800
31x	7000	—2700	—2100	7000
32	5400	3200	1200	9800
32x	8100	—3200	—1700	8100
33	6500	5900	800	13200
33x	5900	—6800	—800	5900
34	6800	7000	—500	13800
34x	5400	—6800	500	5400
35	6500	8400	—2400	14900
35x	4000	—8600	800	4800
36	5100	9700	—2100	14800
36x	5100	—8600	2100	7200
37	5900	10000	—2800	15900
37x	5100	—12400	3300	8400
38	14000	None	—3300	14000
38x	12200	None	3600	15800
39	4000	—7300	—3300	—6600
39x	4900	7300	2800	15000
40	3200	—11100	—1500	—9400
40x	2700	9700	1700	14100
41	1400	—15900	—2700	—18200
41x	1400	15100	2900	19400
42	1100	—15100	—3300	—17300
42x	1100	14000	3300	18400
43	500	—14000	—3300	—16800
43x	300	13200	2400	15900
44	—5700	2200	—5300	—11000
44x	—8100	—1600	6200	—9700
45	—6800	—1400	—6900	—14700
45x	—6800	—1600	6600	8400
46	—7000	1100	—8100	—15100
46x	—8400	—1400	8400	9800
47x	—7800	1900	7000	—7800
48	—7600	—800	—8900	—17300
48x	—10000	1100	8900	—10000
49	—7600	—1100	—7400	—16100
49x	—11100	1900	8900	—11100
50	—5900	—2200	—4900	—13000
50x	—10000	2200	7600	—10000
51	—7300	—1900	—6000	—14200
51x	—9200	1900	7400	—9200
52	—5900	—1800	—5900	—13700
52x	—8400	1900	4500	—8400
53	—5700	—2400	—3600	—11700
53x	—8400	1900	4900	—8400

Minus = Compression.

Table V gives the results obtained from the tests on B frame. This frame weighed 435 pounds. It will be seen that

this frame weighed 33 pounds more than frame A. This, however, would not be true if the frames had similar design of ends, as they would weigh within 1 per cent. of each other if they had the same ends.

The column in the table represents the same items as those of Table IV.

Discussion of Results.

Whenever the subject of design of a truck side frame has been discussed, the question usually has been, "What factor of safety shall we allow?" It is a well known fact that an arch bar type of side frame has a calculated factor of safety of from 12 to 16. This seemingly large factor of safety was not originally used but was arrived at by substituting larger and larger sections in an attempt to overcome breakage, and yet a great many arch bars break, and we usually say that the metal was not of the correct material. The same thing is true of the cast steel side frame. When we find a cast steel side frame broken or cracked, we lay it to the metal, while it may have bene due to the design. In fact it appears that the average designing engineer has been using 25 per cent. mechanical knowledge and 75 per cent. judgment in the design of the different members that go to make up a freight car truck. A careful study of the results of the tests here included will, I think, show some very important factors in the design of cast steel side frames. It shows clearly that we have not been able to figure accurately the stress occurring in the different members of the frame. For instance let us look at the stresses obtained in the tension member of the A frame at reading No. 46x and 69. Reading 46x is on the web side of the L, and reading No. 69 was taken on the top of the lower leg of the L at the front or away from the web. Now it will be seen that the stress at the reading 46x for the direct vertical load is 1600 pounds per square inch in compression, and at the reading No. 69 is 17,600 pounds in tension. Also at the reading 8 and 8x which were taken at the top of the L section, the 8x reading being on the back of the web and the 8 on the front, it will be seen that the 8x reading was 5400 pounds tension, and the 8 reading 16,500 pounds, showing very plainly that the

tension member is attempting to bend in such a way that the two legs come nearer to the center of gravity of the member.

Another place where the stress does not follow what we expect, is at the center and bottom of the frame at reading 29 and 29x. It will be seen that the stress at 29 is 2700 pounds compression, and 29x is 27,000 pounds tension. If we stop to consider we can see why this is true, for the outer edge at point 29 can bend up and relieve itself, thus leaving most of the load for the web side. Now if we look at the results obtained at the same points on the tension member of the B frame where the web is in the center, we will find some variation in results, but nothing like this wide variation. For instance if we take the reading at the bottom of the B frame at 38 and 38x, we will see that the stress is 14,000 and 12,200 pounds per square inch, respectively. The average of the two would be then 13,100 pounds. Now if we should average the two stresses at points 29 and 29x on frame A, we would obtain 12,150 pounds in tension. So it will be seen that the average stress for all practical purposes is the same. It is also true that if we should figure the moment of inertia for the cross section of these two frames at this point, we would find them almost exactly the same.

The same comparison can be made at the lower end of the tension member. That is, the average stress for the direct vertical load on the A frame at points 46x, 69, 8 and 8x, is 9200, and for the same relative point on the B frame, that is points 34, 34x, 11 and 11x, is 8600, which is for all practical purposes the same. That is for the comparison at the bottom of the frames, the maximum stress on the A frame is 27,000 pounds per square inch, and 14,000 pounds per square inch on the B frame, and at the bottom of the tension member the maximum on the A frame is 17,600 pounds and 11,600 on the B frame. That is the maximum stress in the B frame under the vertical load is 50 per cent. less in the bottom member, due to its symmetry of section, and 30 per cent. at the bottom of the tension member in the B frame. This same saving is true in any comparison of the stresses due to the three loads, that is, the twisting, transverse and direct vertical loads. As it will be seen that the maximum indicated stress on the A frame

is 38,100 pounds at point 72, and a maximum of only 19,400 at point 41x on the B frame.

By studying column No. V in each of these tables you will see that there are a great many places where the stress is over 20,000 in the A frame, but none where it is that high in the B frame. In fact there are only five points on the B frame where the stress is over 16,000 pounds with the three forces applied, and there are twenty-four points that show over 16,000 pounds stress on the A frame, and there are seven points on the A frame that show over 25,000 pounds stress. This would clearly indicate that the metal in the B frame was distributed in a manner that each pound of metal was doing a more uniform share of the work than is true of each pound of metal in the A frame.

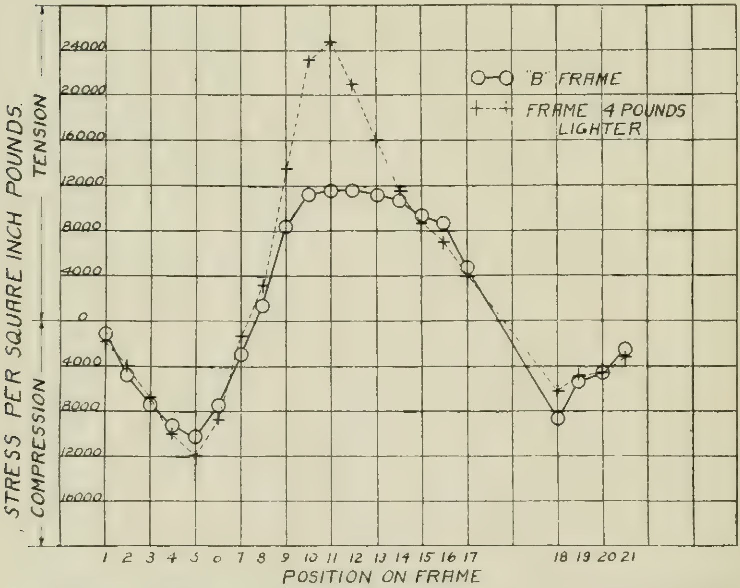


FIG 10. SHOWING A COMPARISON OF STRESSES AT THE DIFFERENT POINTS ON FRAME "B" AND FRAME SIMILAR WITH FOUR POUNDS LESS METAL

The value of a small amount of metal at the correct point is well shown in Fig. 10. Here are shown two curves, one of the curves is plotted from the result obtained under the direct vertical load on frame B at the points 1 to 21 inclusive. These values are represented by circles. The other value plotted as

crosses on the same ordinate are results obtained from a frame made from the same pattern as frame B, but four pounds lighter. This metal was placed as a narrow flange on the B frame, as shown at the top of section A-B Fig. 7. This flange started gradually at point 3 and continued to point 13 where it disappeared into a small bead on each side of the web. It will be seen that the maximum stress at point 11 on the B frame, was only 50 per cent. that obtained on the frame without this flange which weighed four pounds less.

Another place where a small amount of metal can materially reduce the stress is at the bottom flange. The results from four frames tested of similar design except as to width of the bottom flange is given in Table VI.

Table VI. Showing Effect of Different Width of Bottom Member Upon the Stress.

Width of Bottom Member	Maximum Average Stress in Bottom Member Due to Vertical and Twisting Loads
3½	24900
4	20000
4½	16950
5	13300

The maximum stress indicated in this table was obtained by averaging the stresses at the positions on the different frames represented on the B frame at points 41 and 41x, which are the weakest points on frame B under all loads.

The transverse load was not taken into consideration because of the fact that it had very little effect at this point, due to its distance from the point of application of the transverse load. The assumption was also made that the twisting force acts in both directions and the stress due to the twisting would at times be positive on both sides of the frame. It will be noted from this table that the maximum average stress will be almost inversely proportioned to the square of the widths of the bottom member.

From a survey of the results here given it may be seen that the stress is somewhat higher than some of us expected. I am sure we would be very much surprised if we should test an arch bar truck under these methods. The fact is certain that where we have been assuming that we had a low stress,

and that stress of 8,000 to 10,000 pounds has been breaking frames, we will have to change our assumption and say that it will take over 20,000 pound stress to cause cast steel to fail. And I feel that cast steel will stand up under occasional stresses up to 20,000 pounds for a good many years.

If we stop to consider the cast steel bolster we will find that they are getting loads that produce stress of 20,000 pounds, and they are standing up. For instance a bolster which can be figured more accurately than a side frame that has a stress of 10,000 pounds under a load of 68,500 pounds, which is the load used for figuring by some companies, will often get double that load as shown from the tests recorded in the first part of the paper, and thus, you will see that 20,000 pounds stress will be produced in the bolster.

This B frame is not a heavy frame. Its weight is 435 pounds, and as the M. C. B. Association Committee last year recommended to the Association a frame of 500 pounds for 100,000 pound cars, this B frame could be increased 65 pounds, and if the metal were well placed, the maximum stress under the three loads would not be above 15,000 pounds stress at any point. I am confident that if a cast steel frame was never subjected to a stress of over 15,000 pounds, the life would be considerably more than the life of the car.

From the results which I have obtained in the test of some forty different designs by the use of the Berry Strain Gage, I am confident that a cast steel side frame can be designed for any service and for any desired stress, it only remains to decide the maximum stress desired, and then place the correct amount ot metal at the right place.

The use of the Berry Strain Gage, while very new, I am sure will become a great factor in the design of cast steel members for freight cars and other service.

Before closing I wish to acknowledge the assistance rendered by the Pennsylvania Railroad through Mr. D. F. Crawford and Mr. T. R. Cook and others of that road in furnishing a car and moving it over the lines of the Pennsylvania Railroad in order to obtain the first part of this paper. I wish also to express my appreciation to the American Steel Foundries for furnishing me all the casting and apparatus necessary in carrying on this work.

Discussion.

PRESIDENT: I have noticed the marked attention on the part of all the members during the reading of this paper, and a considerable appearance of wisdom on a great many faces, and we will be glad to hear from any one who may wish to add something to the discussion. It may be proper, as Mr. D. F. Crawford, President of the Master Car Builders' Association, seems to be in some degree responsible for this subject, that he give us a few words.

MR. D. F. CRAWFORD: Mr. President, I did not expect to be introduced by my latest title. It seems to me this paper is the result of a very happy combination, one party to the combination being Professor Endsley and the other party the Berry Strain Gauge. The two together have produced and permitted the presentation to us of what must prove to be a very valuable paper to all interested in the subject of car design and construction. As the Professor states, it has been necessary especially in car design to make a great many assumptions, because very little attention has been given to what might be regarded as scientific methods for determining the various stresses to which the various members are subjected. In fact it might be said that it was hardly possible for us to obtain such very complete information as the Berry gauge now gives us. I have not followed Professor Endsley's experiments as closely as I should have done, in view of his very kind acknowledgment of what we have tried to do in helping him. I feel that it is my duty to help him for three reasons: One is that he is Professor of Railway Mechanical Engineering in the University of Pittsburgh; the Department of which I have the honor of being the Director; second, in assisting him by enabling him to obtain data such as he has presented to you tonight, information of much value to the students of the University will be obtained, and third, when such information is carefully reviewed and ably presented it will be of undoubted value to the railways and others interested in the construction of railway equipment.

I, therefore, desire to co-operate with Professor Endsley in his scientific studies—to me they are very practical studies—of car construction. And I think the paper he has presented to you shows that Professor Endsley of the University of Pittsburgh and the Director are trying to develop useful data. I

had a talk with him a day or so ago in which I suggested to him a study of the spring as he sees it in commerce. It is far from being satisfactory material. It does some things that we do certainly not expect it to do from our designs. For instance we do not expect to see so many carloads of springs going away via the scrap pile, and I do not expect to see that after the Professor gets through with his studies of springs.

The design of truck side frames is a matter of great interest to all of us, especially with the increasing capacity of cars now prevailing. Many lines have built cars of seventy tons capacity, which permit of lading up to 155,000 pounds. And our friends of the Norfolk & Western have produced cars, as most of you know, that will carry a hundred tons of the character of coal mined in their territory. So with the increasing demands that we are making of the cars the parts must be made stronger, and while I have never been averse to adding weight to a car to get service, I must approve most heartily and most fully of the remarks made by the Professor in regard to putting the metal at the right place and I am sure we will all have to acknowledge that this paper presents one of the best studies of putting the material at the right place that any of us have had opportunity to go over.

As to the report made by the M. C. B. Association to which the Professor referred, the Committee on Trucks I believe did make a report last year in which they recommended a heavy side frame. Perhaps a wise use of the combination that has been referred to in the beginning of my remarks may induce a later Committee to present a report giving us a side frame that will be quite as efficient and weigh less.

PRESIDENT: Mr. Redding, what is on your mind?

MR. D. J. REDDING: Not very much about side frames, except that I have been thinking while sitting here that if the Professor had made these tests several years ago, he might have saved the steel companies a good many hundreds of failed side frames. Many of those failures might have been prevented had they been properly designed. We have all had a suspicion that it was lack of design to a large extent, but we did not know exactly where to put the metal. We thought the manufacturers knew. I feel that they will derive about as much

benefit from this paper as The Railway Club of Pittsburgh if they study it carefully and profit by the results.

PRESIDENT: How about Mr. Jones, of the American Steel Foundries?

MR. L. E. JONES: I think we have already heard enough from our standpoint tonight.

PRESIDENT: You are satisfied?

MR. JONES: Yes, and I think the railroad people are also satisfied that we are trying to make them the best frame we can and better than they have ever had before. We have been making frames quite a while and we used to think we knew something about them seven or eight or nine years ago, but we now find the stresses and strains to which frames are subjected in service higher than was thought possible a few years ago. We rarely ever make two lots of frames the same. There has been a continual development. Old designs as they have shown weakness are discarded entirely or modified. The frame we are now making is designed to meet the stresses, as they actually occur in service and as explained by Prof. Endsley tonight. While we believe this frame is about right, it is quite possible further improvements can be made, and every time we are called upon to design a frame for a new lot of cars it is pretty certain that in each case these frames will be a little better than any we have made before.

PRESIDENT: There are some people here who make malleable iron. Mr. Frank J. Lanahan, President of the Fort Pitt Malleable Iron Company.

MR. FRANK J. LANAHAN: Mr. President, the position that I am in tonight in connection with the paper read, and the subject it covers, is well illustrated by one of Mr. Irvin Cobb's stories. He tells of a darky of improvident tendancies, out of both money and a job, leaning against a post as the noon whistle blows. As he sees the factory hands all hurrying home, he listens intently, getting the full benefit of the whistle, giving forth its shrill sound, and soliloquizes, "There she goes. Dinn'r time for some folks, but just plain twelve o'clock for me." As I am in the malleable iron business, you will all readily understand the application of the story where I am concerned.

It is somewhat distressing to sit here and listen to a beautifully prepared and well delivered paper upon an article, that if successfully manufactured, puts a decided crimp in the business from which you are gaining your bread and butter. While lacking the enthusiasm of the steel foundrymen for the purposes of Professor Endsley's paper, nevertheless I have keen appreciation of the technical and thorough review he has made of the subject of steel side frames, and it is my hope, before many meetings of the Railway Club to hear Professor Endsley deliver as able a talk upon Arch Bars, with substantial malleable iron columns for support, and then show in comparison when properly designed, how much better is the arch bar truck than the present steel side frame; on the occasion of the delivery of that paper, I can listen to Professor Endsley with far better grace.

MR. CHARLES S. REA: I am greatly interested in anything pertaining to the manufacture of cars and I personally want to thank the Professor for the information he has given me on the construction of Side Frames. I could not make any criticism of his paper, because it is all to the good.

PRESIDENT: Mr. Stark, you have been associated with different departments of railroads for a long time. Let us hear from you.

MR. F. H. STARK: Mr. President, I recently attended a function where several of the speakers paid their compliments to each other. One of the later speakers prefaced his remarks by stating that it took a child two or three years to learn how to talk; that it took some people a great many years to learn when not to talk. I fear I belong to the latter class.

I do want to say a word or two in defense of the old school master car builder. Much has been said about the cut and try methods of pioneer car design and most of such criticism is unwarranted, for most cars built under the old masters stood up well in service quite as well as some of the so-called modern design.

Some years ago theoretical engineers conceived the idea that the ratio of tonnage as compared to tare weight could be largely increased, composite and steel cars were later designed with a hope of revolutionizing car design with a great saving to the railroads. This to a large extent is not materialized and

the practical car designer finds it necessary to return to the old ratio of weight of freight and tare of car.

It is true that there has been some improvement; for instance, the cast iron car wheel; the better distribution of metal; improved foundry practice has made it possible to produce a much better wheel and failures are comparatively unknown, notwithstanding the great increased load imposed, except in the case of flange failures which are due to a limitation as to dimensions.

Take the development of the M. C. B. coupler. With a slight increase in the weight with a better distribution of metal they have been able to increase its efficiency wonderfully and expect with heat treatment to still improve it.

Professor Endsley is a pioneer in the work of determining actual service conditions with a view of designing truck parts to meet the varying conditions. To accomplish this he has used applied science or in other words, theory and practice to obtain practical results.

We are to be congratulated upon having as a member of this club the author of the paper presented this evening which will prove of value to the railroads.

PRESIDENT: May we hear from Mr. Ralston, Mechanical Engineer, Union Railroad?

MR. J. A. RALSTON: This is a subject to which I have not given any study at all. It is very interesting and I am surprised to know of some of the stresses stated in the steel side frame. I do not believe I can add anything to the subject.

PRESIDENT: Do you have to be drafted, Mr. Stucki or will you volunteer?

MR. A. STUCKI: I am a little like Mr. Stark I did not intend to say anything. However, I never come to the meetings of this Club without learning something and this holds good again tonight. It is almost wonderful to be able to determine the working stresses by measuring the elongation and compression and the instrument no doubt requires most careful application.

The paper is exceedingly interesting and a great deal of work had to precede it for which Prof. Endsley, the University of Pittsburgh and Mr. Crawford all three should be heartily

congratulated. It is such co-operation which makes progress possible.

When Prof. Endsley spoke about 25 per cent of engineering science and 75 per cent of common sense having been used in designing heretofore, it reminded me of many cases where the common sense or practical experience was the least negligible of the two, and I for one consider 75 per cent not even enough for the successful designing of railroad equipment.

When I years ago figured the stresses in the 50 ton arch bar truck and found the sections lighter than those of the then standard 40 ton M. C. B. arch bars, I went to the tear-up yard two and three times a week until I was satisfied that the condition of the condemned, although smaller trucks, checked with my figures.

It was stated in the paper that the arch bars break. So they do, but less than any other part of the truck and if they do break, it is in the lower corner, where under normal conditions the stresses are lower than in the neck and the strain gauge of course could not show the stresses, which are due to abnormal conditions breaking the bars, namely, improper fit of column castings, loose column bolts, burnt material.

Prof. Endsley brought out very nicely that the angle section frame is not as strong as the symmetrical section. This was of course realized by the foundries from the beginning, but other gains in the manufacture, such as economy in molding, soundness of castings, arrangement of patterns, cores, etc., were hoped to compensate for the mentioned disadvantage and I personally know of cases where the angle frames have stood the service for years, while the succeeding symmetrical sections have often failed. Some of the steel manufacturers present may be able to enlighten us more fully.

A good many steel castings crack during solidification, others may not pull apart to show the crack, but no matter how careful the annealing is done, such sections will surely fail in service. For test, we usually select sound castings as far as we are able to and the strain gauge naturally shows low stresses. This again proves that a great deal of practical experience and common sense is required to choose sections and designs to overcome such dangerous conditions. With this in view I have often seen castings strengthened by taking out material.

The same remarks could be repeated in regard to blow holes in the castings. Most of the failures I know of are due to this cause and to obtain a fair degree of safety in this respect again requires almost unlimited experience and common sense.

I fully agree with the author that the lateral strains are small and I do not recall a single failure of truck side frames due to this cause, and if we consider that the 50-ton arch bars are only 5″ wide and stood up for so many years, proves again the correctness of the statement.

Regarding the transverse strains coming on a truck frame, the case is not so clear. In a rigid truck the forces are tremendously large; in a flexible or loose truck, especially if the contour of the wheel is fairly good, these strains are fairly small; and if the connections between the spring plank and the truck sides are entirely loose, making the spring plank simply a tie, these strains are nill.

The unfortunate part in testing truck sides and other similar railroad material is the fact that the service conditions are so complex and so variable that it is almost impossible to produce actual conditions during the test.

MR. LANAHAN: I trust that the Superintendents of Motive Power, Master Mechanics, and those engaged in the car business have listened to what Mr. Stucki has said relative to the arch bar truck. I join with the gentleman in thanking Professor Endsley for the able preparation of his paper, and in common with the other members of the Railway Club, thank Mr. Crawford and the Pennsylvania Company for their helpful assistance.

In gratitude, however, I turn to Mr. Stucki, and most heartily thank him for the crumbs of comfort he so generously extended to those whose business is so vitally affiliated with the arch bar truck.

In fact "our unique friend" is a little more liberal than was the wife of a certain Irishman. Suffering from a fatal disease, this son of Erin was about to pass away. His daughter sitting beside him, holding his hand as he tossed in the bed from side to side. For a moment he was still, sniffing the atmosphere, he said "Mollie, I think I smell cookin' " She said "Yes Mother is making some doughnuts." He said "Mollie I think, I could ate some of th'm doughnuts, I wish you would

go and get me one." She answered "Alright I'll go and ask Mother." In a few moments, the dutiful daughter came back, and sat down beside the bed, but remained silent. Her father said "Mollie, what did your mother say?" Mollie replied, "She says, no you can"t have any, that they're for the wake."

PRESIDENT: Mr. Gale, of the Pressed Steel Car Co.

MR. C. H. GALE: I wish also to express to the Professor my thanks for the few crumbs of comfort thrown out to the steel foundry men in saying that it is not altogether due to fault of the steel in these frames that so many of them failed. I know that steel foundry men who have been in the business, have for a long time felt that they were abused, that there was some fault elsewhere than in the foundry.

There is another matter that he touched upon which I think may give some comfort to some steel foundry men. I know of some of them engaged in the steel castings business who some few years ago thought very seriously of going into the business of making steel side frames, but owing to the many failures and the great scrap piles they saw in different yards they came to the conclusion that the cast steel side frame was not going to last long and they would not be warranted in going to any great expenditure of money for the necessary equipment. But from the research work the Professor has engaged in showing where the addition of just a little more metal, or perhaps not adding but just shifting the place of the metal, will make a frame that will prove satisfactory and reduce failures to the minimum, the steel foundry men may feel encouraged to go into the business more heavily.

PRESIDENT: Professor Endsley, will you close the discussion?

PROFESSOR L. E. ENDSLEY: I might add a word with regard to what might be obtained in a test of an arch bar truck. I think I will have to take exception to what Mr. Stucki said with regard to the Berry Strain guage not recording the true stresses in the arch bar truck. Mr. Stucki pointed out that the arch bar fails at the lower corner of the bottom arch and that checks exactly where the majority of the cast steel frames fail. I think probably ninety per cent of the trouble of both the arch bar and the cast steel frames has occured at the lower corner of the bottom arch. Mr. Stucki points out that

this point under normal conditions shows less stress than other points of the arch bar. I assume, of course, that he means when we use the ordinarily accepted method of figuring it under normal conditions. This shows very clearly what I stated in my paper, that we have been unable to figure accurately the stress coming at different points of the side frame. To make it more clear, probably when a side frame is loaded, either in service or in a testing machine, there are two sets of stresses. One set of stresses is due to the truss action of the load on the side frame, and the other is due to the bending of each individual member. That is, in the cast steel side frame, all tension and compression members are tied together at the ends and we do not have a pin point connection at the ends of the members such as bridge designers have had. Of course, when a bridge design has pin point connections entirely the stresses set up in the different members can be figured accurately, but when the ends of the tension and compression members are tied together by plates, other stresses are developed due to the bending of the members, and these stresses must be taken into consideration. While the members in bridge construction are rather long in comparison with their width, the members in the cast steel side frame are rather short with regard to their width. I have found in some cases the bending stresses to be double the stresses due to the truss action.

Now in the arch bar truck you have the ends of the members tied together, not exactly in the same way, but at the lower corner of the lower arch bar, you have two tension members coming together through the lower bend. This horizontal part is also under the bending stresses due to the load which is supported between the two columns, and you are here getting bending stresses along with the truss action. So that it is almost impossible to figure what these stresses may be, but the Berry Strain gauge applied at any of these points will show the total elongation of any member at any point, and this elongation or compression, can only be due to the stress equivalent to this elongation.

The Berry Strain gauge will not tell you whether it is the truss stress of a bending stress, but it will give you the sum of all stresses at that point.

In regard to the bottom arch bar not fitting as Mr. Stucki

states, this will induce another bending of the bar until it seats itself at this point, and induce other stresses, which give abnormal stresses at this point, but should the Berry Strain guage be applied to the arch bar truck thus equipped, it will give you the total stress occurring at this point under any given load.

I am very glad indeed to hear Mr. Stucki say that we must use our common sense. We all must use a large amount of common sense in any design. Of course, the foundry practice will probably alter some of our figures and designs and I would not want to say that you could design a cast steel side frame in the laboratory alone, but after you know the forces you are going to get, you can put these on the frame and like causes will produce like result. There is no difference between theory and practice when all the facts are known. Theory does not know all of the facts many times, nor does practice, but when we get all the facts, theory and practice lock arms and walk off together.

Far be it from me to say any thing against the arch bar truck. I have never tested an arch bar truck in the manner in which I have tested the cast steel truck. My paper tonight merely gave you what I consider some very important facts with regard to the design of cast steel side frames, but I am very sure that the Berry Strain guage will give you the stress in any member whether it be cast steel or rolled steel. In fact I have used the Berry Strain guage on design of brake beams and whenever a brake beam begins to take set as a whole there are being developed stresses, some place in the beam which are above the elastic limit of the metal. I have checked this several times in brake beams.

As far as initial stress in cast steel, mentioned by Mr. Stucki, is concerned, we may have some initial stress at the different points, but if this initial stress is there, that point will begin to take set before the elastic limit of the metal is indicated at that point. In that way we can determine where the initial stress is in the frame. If we have a metal that should take set at 30,000 pounds per square inch in tension, and it takes set at 20,000 pounds per square inch, we would immediately know that an initial stress of 10,000 pounds per square inch is there. In fact from an initial stress of 3,000

to 4,000 pounds is very large for unannealed castings. In an annealed casting the initial stress is too small to determine. In fact the variation in the elastic limit is greater than the actual amount of initial stress. I firmly believe in annealing casting and if the annealing is well done, you will obtain frames without appreciable initial stress. There are a good many things which developed during these tests which I have not told you about, but it would take three or four meetings to give you the whole thing. My main thought in writing this paper was to give you the meat of the argument, and I thank you for your patience.

MR. CRAWFORD: May I say a few more words: There seems to have been some discussion aroused between the arch bar and steel side frame. My understanding of the Professor's paper is that he was only bringing out the facts regarding the steel side frame. Just as soon as whatever is holding back business quits holding and lets us have a little more prosperity I will ask the Professor to co-operate with us, in getting the data regarding the standard arch bar truck in the same way he has gotten it for the steel side frame truck. Then he can present another paper, and Mr. Stucki and Professor Endsley can meet on common ground with full facts on both kinds of construction.

MR. LANAHAN: That puts me in the position of the Scotch Minister who was delivering his first sermon before a strange congregation. After rising in the pulpit, he was quiet for a long time before starting his discourse. He kept his eyes riveted up to the choir loft, and the congregation looked at him expectantly. Quite a long time elapsed, and still the sermon was not started. Finally he said "Brethren and Sisters, there is a laddie up in the gallery who is kissing a lassie, when he stops I'll begin." It is not my understanding that Mr. Stucki shows any inclination to waiver in the kind things he has said about the arch bar truck, so there is no necessity of a sermon from me on the subject. However, I would like to make a little proposition.

Mr. Crawford has kindly offered the use of the Pennsylvania Lines for a similar test of the arch bar truck that has been accorded the steel side frame. Gladly will I offer the services of the Fort Pitt Malleable Iron Company to furnish the malle-

able iron columns, and I am quite sure that the bar iron manufacturers and the nut and bolt people will most willingly cooperate with us in conducting experiments which will mean so much to their respective trades, giving the railroad fraternity some important light upon the arch bar proposition.

MR. A. G. MITCHELL: I move that a vote of thanks be tendered to Professor Endsley by the Club for his very interesting and able paper, and also to his worthy assistants who attended and helped him in the work.

The motion was duly seconded and unanimously agreed to by rising vote.

There being no further business,

ON MOTION, Adjourned.

J. B. Anderson
Secretary.

RAILWAY CLUB NOTES.

The following subjects were presented and discussed by the several Railway Clubs during the month of February as noted below:

New York Railroad Club, Harry D. Vought, Secretary, 95 Liberty Street, New York, N. Y.

SUBJECT: Train Despatching by Wireless, by L. B. Foley, Supt. Telegragh, D. L. & W. R. R.

St. Louis Railway Club, B. W. Frauenthal, Secretary, Union Station, St. Louis, Mo.

SUBJECT: Why Are Superheaters Essential for Decreasing the Expenses of Railroads, by R. M. Ostermann, Locomotive Superheater Co.

New England Railroad Club, Wm. E. Cade, Jr., Secretary, 683 Atlantic Avenue, Boston, Mass.

SUBJECT: Railroad Fuel Economy, by M. C. M. Hatch, Supt. Fuel Service, D. L. & W. R. R.

Western Railway Club, Jos. W. Taylor, Secretary, 1112 Karpen Building, Chicago, Ill.

SUBJECT: What is a Locomotive, by George S. Goodwin, Mechanical Engineer, C. R. I. & P. Ry.

Canadian Railway Club, Jas. Powell, Secretary, Chief Draftsman G. T. R., Montreal, Canada.

SUBJECT: Toronto Grade Separation, by J. R. W. Ambrose, Chief Engineer, Toronto Terminals Railway Co.

Richmond Railroad Club, F. O. Robinson, Secretary, c-o C. & O. Ry., Richmond, Va.

SUBJECT: New York Terminals, by H. S. Balliat, Signal Engineer, Grand Central Terminal.

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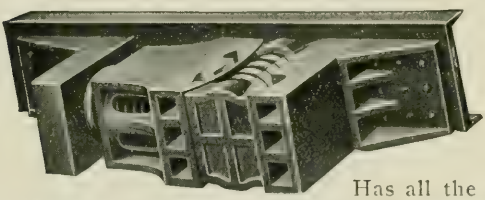

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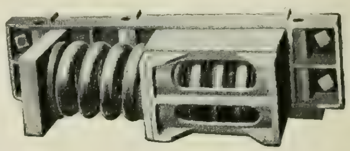

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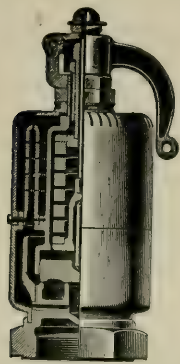
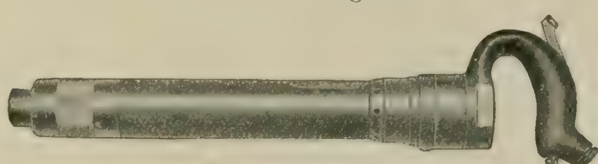
Vol. XIV. MARCH 26, 1915 No. 5.

REPORT OF STANDING COMMITTEE ON REVISION OF MASTER CAR BUILDERS RULES OF INTERCHANGE.

By MR. R. L. KLEINE, Chairman.





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A. G. MITCHELL..........................November, 1912, to October, 1914.

* Deceased.

Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING.
MARCH 26, 1915.

The regular monthly meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock, P. M., by President, F. M. McNulty.

The following gentlemen registered:

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Cooper, J. H.
Cotton, A. C.
Courson, C. L.
Courtney, D. C.
Crenner, J. A.
Dickinson, F. W.
Dillon, S.
Ferren, R. O.
Fitzgerald, D. W.
Fogle, E.
Forsythe, G. B.
Freygang, A. H.
Fulton, A. M.
Gies, Geo. E.
Grewe, H. F.
Gross, C. H.
Hammond, H. S.
Harsch, A. M.
Haynes, J. B.
Hepburn, M. J.
Herrold, A. E.
Hettler, R. C.
Hindman, S. M.
Hoffman, J. M.
Howe, D. M.
Huchel, E. W.
Huchel, H. G.
Huff, Geo. F. Jr.
Hughes, Jos. T.
Irwin, E. P.
Jameson, A. A.
Johnson, E. A.
Kelly, H. B.
Keptner, J. B.
Kinch, L. E.
Kinter, D. H.
Klein, R. A.
Kleine, R. L.
Knight, E. A.
Knight, E. H.
Koll, J. F.
Lanahan, Frank J.
Lawley, R. N.
Lidstone, F. J.
Lindner, W. C.
Lindstrom, Chas. A.
Lobez, P. L.
Long, R. M.
Low, J. R.
Lyle, D. O.
Lynn, Saml.
Maier, J. L.
Marcus, M.
Marshall, W. T.
Mason, Stephen C.
Mask, H. N.
Maxfield, H. H.
Mensch, E. M.

Milligan, E. Jr.
Mott, Saml. L.
Murdoch, H.
Murphy, W. J.
McCann, J. P.
McCollum, G. C.
McCurdy, C. E.
McDermitt, W. W.
McKinstry, C. H.
McNaight, A. H.
McNulty, F. M.
Neel, T. M.
O'Connor, M.
Painter, Jos.
Postlethwaite, C. E.
Preen, John
Rabold, W. E.
Redding, D. J.
Richardson, L.
Ridley, R. C.
Robbins, F. S.
Robbins, J. A.
Roemer, W.
Rowand, T. A.
Scott, R. T.
Schaick, W. L.
Searles, E. J.
Seewald, J. H.
Sheets, H. E.
Sleeman, W. C.
Smith, D. W.
Smith, E. M.
Smoot, W. D.
Stark, F. H.
Straub, V. V.
Streib, G. A.
Stucki, A.
Taylor, F. C.
Thomas, J. H.
Turner, L. H.
Vowinkel, F. F.
Walther, G. C.
Warfel, J. A.
Way, E. S.
Wilson, T. A.
Wood, H. L.
Wyke, J. W.

VISITORS.

Armstrong, L. N.
Calvin, A. W.
Converse, W. A.
Cox, W. W.
Francis, T. E.
Grusch, A. E.
Gruver, Dr. A. B.
Haynes, F. L.
Jay, A. R.
Keegan, J. E.
King, C. C.
Lacklin, E. B.
Maxwell, F. B.
Morrow, W. M.
Murdoch, E. A.
Parry, F. C.
Pfeiffer, C. A.
Pickles, H. D.
Potter, C. T.
Roth, J. F.
Shadle, C. S.
Steel, L. C.
Stenson, G. A.
Stroh, W. N.
Tellep, H.
Walker, Sylvester
Wilder, H. W.
Wrigley, C. B.

PRESIDENT: The roll call will be dispensed with, as we have a record of the attendance from the registration cards.

The reading of the minutes will be dispensed with, as they are now in the hands of the Printer and will be in your hands in a few days.

The Secretary will read the list of applicants for membership.

SECRETARY: We have the following applications for membership:

Calvin, A. W., Draftsman, A. Stucki Co., 1211 Sandusky Street, N. S., Pittsburgh, Pa. Recommended by A. M. Fulton.

Grusch, A. E., Bill Clerk, Penna. Co., 76 North Starr Avenue, Bellevue, Pa. Recommended by George E. Gies.

Kummer, Jos. H., Chief Clerk, Fort Pitt Malleable Iron Co., 209 Greydon Avenue, McKees Rocks, Pa. Recommended by Frank J. Lanahan.

Meigs, Robert R., Motive Power Inspector, Penna. R. R., 28th and Liberty Avenue, Pittsburgh, Pa. Recommended by H. H. Maxfield.

Saints, Chas. A., Salesman, A. W. Cadman Manufacturing Co., 2814-2816 Smallman Street, Pittsburgh, Pa. Recommended by F. S. Robbins.

Shadle, C. S., Assistant M. W. Storekeeper, Penna. R. R., 7333 Kelly Street, Pittsburgh, Pa. Recommended by L. E. Kinch.

Smith, F. C., Chief Clerk, Passenger Train Master, P. & L. E. R. R., 3040 Merwyn Avenue, Pittsburgh, Pa. Recommended by F. H. Babcock.

Stroh, W. N., General Manager, Kennedy-Stroh Co., Pittsburgh Athletic Association, Pittsburgh, Pa. Recommended by H. S. Hammond.

Walker, E. H., Vice President, The Standard Coupler Co., 30 Church Street, New York, N. Y. Recommended by J. G. Code.

This brings our membership up to 1101.

PRESIDENT: Upon approval by the Executive Committee of these applicants these gentlemen will become members.

There being no further business, we will now have the Rport of the Standing Committee on Revision of M. C. B. Rules of Interchange which will be presented by the Chairman of the Committee, Mr. R. L. Kleine.

MR. R. L. KLEINE: Mr. President, Members of The Railway Club of Pittsburgh, and visitors:—I do not propose to read all the recommendations made by the Committee. The printed Report has been in your hands for a week, and it is to be presumed that you have all read it. While these recommendations might appear rather voluminous, the Committee worked pretty hard in an effort to clear up the Rules. We had a request from members of the Arbitration Committee not to make any more changes in the Rules this year than were absolutely necessary in order to bring them up to date and to avoid any discrepancies.

However, after the Rules were adopted last year the Arbitration Committee found it necessary to issue two circulars, Nos. 9 and 16, interpreting the Rules. And I might say that in interpreting the Rules some of them were somewhat changed, with the result that after these interpretations were put out there were still differences of opinion among the railroads as to just what was meant. Take for example Rule No. 33, which relates to brake shaft. The 1914 rules made the handling company responsible for brake shaft. The Arbitration Committee, in interpreting what was meant by Rule 33, included all the items which were attached to the brake shaft and in that way amplified the rule. Notwithstanding all this, the question comes up now whether a brake chain bolt is a delivering company or owner's responsibility. The amount of correspondence on that one item alone has been so voluminous that really the rule ought to be clarified.

With that idea in view the Committee has gone through the entire Rules, also through the prices, and presents to you a price where none is given in the Rules now, or where there is a difference of opinion as to that price. For example, one road will charge 5 cents for an item. Another road will charge 3 cents for the same item. The road that charges 5 cents receives an objection from the road that charges 3 cents, and there is no way in which to settle the question and either the road that charges 5 cents must change to 3 cents or the road that charges 3 cents must change to 5 cents. For these reasons we have offered a good many changes in the Rules. But each one is made simply in an effort to clarifiy the Rules and avoid the continual correspondence that is going on among the rail-

roads. I will read only the most important changes in the Rules, leaving out the question of prices, with your permission.

ANNUAL REPORT OF STANDING COMMITTEE ON REVISION OF M. C. B. RULES OF INTERCHANGE.

Mr. President and Gentlemen:

Your Standing Committee on the Revision of M. C. B. Rules of Interchange held their annual meeting at the Monongahela House, Pittsburgh, Pennsylvania, February 25th and 26th, 1915, and went over the 1914 Interchange Rules very carefully and thoroughly, and submit herewith their recommendations for changes.

It was brought to our attention that the Members of the Arbitration Committee were desirous of keeping down the changes in the Rules of Interchange to a minimum, in which thought your Committee thoroughly concurs. However, after the last issue of the rules, two circulars, Nos. 9 and 16, were issued as interpretations of the 1914 Code of Interchange Rules, in order to make them clear and bring about a uniform practice. Your Committee has found that, aside from these interpretations, there are still quite a few items which are not uniformly understood by the various railroads, and which is resulting in endless correspondence between roads, in their settlement of car repair bills. For these reasons, your Committee feels that the rules should be so modified, at this time, that they embody the meanings of these interpretations, as well as clear up any misunderstandings; and it is in this spirit that the changes are recommended.

RECOMMENDED CHANGES IN THE M. C. B. RULES OF INTERCHANGE.

PREFACE.

Paragraph 2, line 3: Omit the words "derailment or accident."

Explanation: Under this code of rules, it is generally understood that the handling company (commonly known as the delivering company) is responsible for

damage done to any car due to unfair usage, derailment, cornering, sidewiping or unconcealed fire damage. The rules define unfair usage in the heading over Rules Nos. 37 to 42, as follows: "Combinations of damages to cars with wooden underframes or composite wood and metal underframes which denote *unfair usage,* if existing at the same end of car and requiring repairs or renewals." It will be noted that no mention whatever is made of collisions, and it is the general practice of some railroads to bill repairs to the car owner, if the same do not form a combination of defects as defined in Rules Nos. 40 to 42, and the car does not show evidence of having been derailed, cornered or side-wiped; whereas, other railroads keep a careful record of all damage in classification of cars from the standpoint of discipline to car droppers exceeding a set limited speed at coupling, and use these accident reports in connection with assuming any damage shown by these reports. This matter, therefore, resolves itself into "what is an accident," which depends upon the construction and the physical condition of the car being handled, and the local yard rules in force governing the speed while coupling in classification. In order that there may be a uniform understanding between roads, and to eliminate the present controversy, the rules should be made clear in this respect; and to cover the matter, we recommend the above modification in the Preface, and changes in Rules Nos. 32 and 63, which later will appear under their respective headings.

RULE No. 1.

Change to read: "Each railway company must give to foreign cars, while on its line, the same care as to inspection, oiling, packing, adjusting brakes, *angle cocks, tightening unions* and repairs, that it gives to its own cars, *except as otherwise provided.*"

Explanation: Change to consolidate in Rule No. 1 such repairs that are not billable, (see Rule No. 108,) and for the purpose of defining the repairs that should and can be made.

RULE No. 2.

Paragraph 2, change to read: "Empty cars offered in interchange must be accepted if in safe and serviceable condition, except that a car destined to a point outside of switching district, safe to carry load to destination, must be accepted, when empty, if moving on its home route, and if in the same general physical condition as it was when forwarded under load. The receiving road to be the judge, in all cases. Owners must receive their own cars, when offered home for repairs, at any point on their line, subject to the provisions of these rules."

Explanation: To amplify rule in accordance with interpretation of Arbitration Committee, in Circular No. 16, page 1, concerning Rule No. 2.

Section E, paragraph 2, change to read: "A. R. A. Car Service Rule No. 15 to apply (see page 112) when transfer or rearrangement of lading is necessary, provided the repairs cannot be made while the car is under load."

Explanation: This paragraph reads that when transfer or rearrangement of lading is necessary. It has been found that requests for transfer authority have been made where the repairs could have been made at most any point by an ordinary repairman, the cost of transfer in some cases amounting to considerably more than the cost to repair the car.

Section E, paragraph 5, change to read: "When load is destined to a point inside of switching district and is not transferred, the car may be returned, when empty, to the delivering line, properly side-carded with a 'BAD-ORDER, RETURN WHEN EMPTY' card, showing the defects for which the car is returned, in which case it must be accepted. (For card see page 102.)"

Explanation: To clarify rule in accordance with interpretation of Arbitration Committee, in Circular No. 9, page 2.

RULE No. 3.

Paragraph D: Change the word "journals," in second line, to "axles."

Explanation: Rule is intended to apply to the entire M. C. B. axle.

Paragraph E, change to read: "After January 1, 1916, tank cars (empty or loaded) will not be accepted in interchange unless they conform to the M. C. B. Specifications for Tank Cars."

Explanation: To enforce a strict compliance with the tank car requirements as a whole, as covered in the Preface, and as required by the Interstate Commerce Regulations and Tank Car Requirements.

Paragraph F, eliminate the date "After October 1, 1915."

Explanation: The rule is effective with the date of the issue of the new rules.

New paragraph "O": "Cars equipped with collarless journals will not be accepted after October 1, 1917."

Explanation: There are but few collarless journals still running, no repair parts are carried in stock, and such cars as are equipped with collarless journals and requiring repairs on a foreign road are unduly delayed; the handling road being responsible for per diem.

RULE No. 7.

Paragraph 1, change to read: "When repairs of any kind are made to foreign cars, a billing repair card must be made out showing all information called for by the billing repair card, and such other detail information as is required by the rules."

Explanation: The first sentence of this rule has been reworded to cover, in a general way, the information that must be shown on billing repair card. The last sentence which refers to specific information has been eliminated and included under Rule No. 9, in order to give these details more prominence and where this information properly belongs.

RULE No. 8.

Change to read: "Billing repair card shall be made in duplicate, the original to be known as the billing repair

card, and the duplicate to be known as the record repair card, and to be of the forms shown on pages 107, 108, 109 and 110, all items of repairs to be in handwriting.

"Note: Use of present forms, if not conforming to recommended forms, may be continued until stock is exhausted."

Explanation: Wording of rule to cover a new form which has been recommended for a wheel and axle billing repair card (per copy attached,) which form should be shown on pages 109 and 110. See recommendations under Rule No. 96 for elimination of form now shown on page 109.

RULE No. 9.

Add a new marginal reference, together with additional items, in a bracket opposite same, as follows:

	(Repairs made and reasons for same.	
	(Date and place where made.	
	(Name of road making repairs.	
	(Location of parts repaired or re-	
General	(newed, as per Rule No. 14.	
	(Weights of forgings, castings, etc.)	To be
	(Feet of lumber.)	shown
	(Value of miscellaneous items.)	opposite
	(Hours labor.)	each item.

Explanation: The first four items have been transferred from Rule No. 7 to Rule No. 9, which specifies certain information that must be shown on billing repair cards. The additional items recommended in the same bracket will make it compulsory, on the part of all roads, to show this information on the billing repair cards, whereas at the present time, some roads fail to show these details on their billing repair cards, and only enter them on the bill form, which practice seriously interferes with a proper and rapid checking of the charges.

RULE No. 14.

Paragraph 3, line 6: After the word "crosstie" add "or on center sill."

Explanation: There are a large number of cars equipped with the fish-belly type of center sills. No intermediate sills and angle side sills on these cars, the most available place for the cardboard is on the center sills.

RULE No. 17.

Paragraph E, add new sentence as follows: "M. C. B. No. 1 beam is standard for cars weighing 35,000 lbs. and less; M. C. B. No. 2 beam is standard for cars weighing over 35,000 lbs. Where any cars weigh 35,000 lbs. or less, and are equipped with No. 2 beams, and the cars so stencilled, M. C. B. No. 2 beams must be applied in repairs."

Explanation: To make clear to repairmen under what conditions M. C. B. Standard No. 1 and No. 2 brake beams should be used.

Paragraph I, amended to read, by adding note:
"Note: This does not include the third leg of grab iron nor the center arm of uncoupling levers which extend to both sides of car."

Explanation: It is impossible to renew this type of rod without welding center arm or to construct a handhold with three legs without welding on the third leg and make a substantial job.

Paragraph J, new paragraph: "Arch bars must not be welded when making repairs to foreign cars."

Explanation: There have been numerous failures of these parts as a result of same having been patched or welded. It is, therefore, considered a dangerous practice and one that should be prohibited.

RULE No. 21.

Section A, add the following after word "roof" in last line, changing period to semi-colon:

"or for the cost of applying temporary hand-railings to, or boarding over the opening on, empty well-hole cars."

Explanation: To make these cars safe for trainmen when moving empty.

RULE No. 22.

Paragraph 2: The dimension "12 inches" in this rule should be changed to read "8 inches." Rule to read as follows: "The splice may be located either side of body bolster, but the nearest point of any splice must not be within 8 *inches* of the same, excepting center sills, which must be spliced between body bolster and crosstie timber, but not within 24 inches of body bolster."

Explanation: Lessening this distance 4 inches will often permit splices to be applied in front of bolsters which otherwise would have to be made back of bolsters. The front splice is preferable and less expensive.

RULE No. 32.

Change to read: "Damage to body of car, due to unfair usage, derailment, *cornering, sideswiping* or *unconcealed fire damage.* Defect cards shall not be required for any damage so slight that no repairs are necessary, the receiving line to be the judge."

Explanation: See explanation under Preface.

RULE No. 33.

Remove from bracket and change to read: "Owners will not be responsible for the expense of repairing or replacing ladders, handholds, sill steps, brake shafts, brake wheels, ratchet wheels, brake pawls, ratchet and pawl plates, upper brake shaft bracket, brake step board and brackets, brake shaft casting where same is used to secure brake shaft to roof of car, brake chain bolt when in connection with repairs to brake shaft; also, any bolts, rivets, nuts or keys, used in securing the above parts, whether or not in connection with other repairs."

Explanation: Rule has been revised to include all of the detail parts that have been included in the Arbitration Committee's interpretation of this rule in Circular No. 9, which will avoid any future misunderstanding of the rule.

Arbitration Committee in Circular No. 9 recommended the elimination of prices for straightening handholds, sill steps, brake shafts, etc.

Recommendation: "That these items be retained for uniformity in charges in cases of cars damaged at industries located on handling line, cars loaded up and shipped home, or cars damaged on the handling road by the crew of another road."

RULE No. 34.

Insert new rule: "Missing end gates on gondola cars, or missing all-metal end door or all-metal side door on house cars."

Explanation: End gates on gondola cars do not become missing in fair usage. They are sometimes removed by the shipper when loading twin loads, to provide clearance between lading and car floor, and again the consignee removes them to facilitate the removal of other ladings, so as to avoid passing the lading over the top of the end gate. As these end gates are now owners' defects when missing, they are not reapplied, placing an unnecessary and wasteful burden on the car owner.

All-metal side and end doors are secured to cars in such a manner that it is practically impossible to lose them in fair usage. When missing, they are invariably found on the line of the delivering company, and on account of the high cost of these doors, the road having the door in its possession should be penalized to the extent of issuing a defect card when offering the car in interchange with one of these doors missing. The all-metal steel door is an entirely different proposition from the old-style wooden door with its insecure fastenings.

RULE No. 36.

Paragraph 2, change to read: "Special Cards: Required by the Regulations for the Transportation of Explosives and Other Dangerous Articles, by Freight, formulated by the Interstate Commerce Commission. They shall be used, be of the text and size described, and be attached to cars as prescribed by said regulations."

Explanation: This complies with the interpretation of this paragraph in Circular No. 16.

RULE No. 40.

Change to read: "Damaged end sill accompanied by damage to two continuous longitudinal metal center or draft sills."

"Note: The above combination of damages does not apply to cars with a sectional area of less than 16 sq. in. in the center or draft sills."

Explanation: The combination of damages for wooden underframe cars in the present Rule No. 40 is unsatisfactory, as it is resulting in partial repairs being made to wornout parts of cars or delay in obtaining car owners' authority for repairs, and if repaired without owners' authority, results in refusal to pay the bill. When complete and proper repairs are not made, it directly affects the safety of the car; on the other hand, some railroads and individual companies have strengthened their cars by applying metal center draft members of approved design and sectional area and such cars should be protected.

RULE No. 41.

Add new note under this rule: "The center sill filler, either short or full length, extending from end sill to end sill, when renewed in connection with center sills, will not enter into combination."

Explanation: These center sill filling timbers are bolted to center sills and, therefore, fail when the center sills fail; in fact, the crosstie bolts tend to weaken this built-up structure which acts as one member, and the filler timbers should not, therefore, enter into a combination.

RULE No. 42.

Eliminate the first note following this rule, if Rule No. 40 is eliminated.

RULE No. 60.

Following the word "tested" in second line, add: "Or dirt collectors not cleaned."

Explanation: Present rules provide a price for this work, but do not state when the work shall be done.

These dirt collectors should be cleaned at intervals of twelve months.

RULE No. 63.

Change to read: "Damage of any kind to the trucks due to unfair usage or derailment, that requires renewal or repairs."

Explanation: Changed to conform with change in Preface.

RULES Nos. 70, 74, 80, 83 and 98; also, notes under Figures 3 and 4:

Change the words "forged or rolled" as used in connection with steel wheel, to the word "wrought."

Explanation: These wrought steel wheels are made under various processes, some being rolled, some forged, some pressed, and still others a combination of these various processes. The term "wrought steel wheels" covers the various methods cf manufacture. At present, some cars are stencilled "Forged steel wheels," "Steel wheels" and "Wrought steel wheels" and if a general term, "Wrought steel wheels" is used, it will also lead to uniform stenciling.

RULE No. 82.

New rule—to be removed from bracket:

Cast iron wheels applied to foreign cars must not be of less weight than the minimum requirements of the recommended practice of the M. C. B. Association, for the capacity or maximum weight of car under which they are used, as follows:

Cars Marked With "Capacity" Not Greater Than Pounds	Cars Marked With "Maximum Weight" Not Greater Than Pounds	Minimum Weight of New Wheel Not Less Than Pounds
100,000	161,000	715
80,000	132,000	665
60,000	95,000	615

Explanation: This rule is considered necessary to avoid the application of wheels that are not of sufficient

weight and strength for the capacity of car under which they are to be used, and in order to avoid the liability of wheel failures that may result from the application of wheels not suitable to the capacity and weight of car.

RULE No. 85.

Following the word "usage" in last line, add an additional sentence, as follows: "Except that when axles are removed on account of wheel defects, and the journals have increased in length more than 3/8 inch, or the collars are worn to less than 5/16 inch, the axles shall be considered as scrap, as they cannot be reapplied to foreign cars. (See Rule No. 29.)"

Explanation: The revision as recommended will remove all doubt as to a possible confliction between Rule No. 85 and Rule No. 29, and will make it clear that Rule No. 29 provides for shop limits and Rule No. 85 for road limits.

RULE No. 95.

Paragraph 4, line 2: Omit word "cotters."

Explanation: To make this rule conform to Rule No. 101, which gives the price of cotter when applied independently, as 3 cents. No labor allowance permitted.

Add a new paragraph at the bottom of this rule, as follows: "Friction draft gears, complete, whether or not lost with coupler."

Explanation: This material is very valuable and when reclaimed, the majority of parts are usually in good condition, and should have at least the same protection as brake beams and couplers.

RULE No. 96.

Paragraph 1: It is suggested that the statement form shown on page 110 should be corrected by converting the four columns for scrap credits into one column with the caption "Credit for Scrap."

Explanation: All scrap material for which these columns are used is now covered by one price per pound.

Paragraph 2: Eliminate second paragraph of this rule and, also, the form shown on page 109, as this form is not generally used and is not desirable, for the reason that all necessary information in connection with renewal of wheels and axles should be shown on a special billing repair card for wheels and axles, which is recommended and covered by proper reference in proposed revision of Rule No. 8.

Note: By showing the proposed billing and record repair card for wheels and axles, on pages 109 and 110, will necessitate advancing the bill form now shown on page 110 to another page.

RULE No. 97.

Eliminate the first three words of this rule, namely: "Bills or statement" and substitute the words "Billing repair cards."

Explanation: This is necessary in order to harmonize with previous recommendations in Rule No. 8, and in connection with the proposed wheel and axle billing repair card.

RULE No. 98.

Make the following changes in scrap prices of axles: (These prices based on average weight of axles at $0.006 per pound.)

	Scrap
One axle, 50,000 pounds, or under	$1.95
One axle, 60,000 pounds	2.45
One axle, 80,000 pounds	3.85
One axle, 100,000 pounds	4.70

Add new paragraph following the table of prices in Rule No. 98:

"The following average scrap credit prices must be allowed for wheels removed from dismantled cars, under the provisions of Rule No. 120:

	Scrap
"One cast iron wheel, 50,000 pounds capacity, or under	$2.75
"One cast iron wheel, 60,000 pounds capacity	2.90
"One cast iron wheel, 80,000 pounds capacity	4.75
"One cast iron wheel, 100,000 pounds capacity	4.75"

Explanation: The per pound price for 60,000 pounds and 50,000 pounds scrap axles has been eliminated, and the prices recommended by the committee on prices for labor and material in Circular No. 9 substituted, except that even amounts are shown instead of the odd cents, in order to simplify billing.

The additional paragraph showing the average scrap price for wheels of 60,000 pounds capacity and under is suggested in accordance with prices recommended in Circular No. 9. Wheels of 80,000 and 100,000 pounds capacity have been added and a scrap value of $4.75 shown, this being made to correspond with the present average credit price for these wheels, for the reason that cars of this capacity are not frequently dismantled and the wheels are more liable to be fit for further service than is the case with the smaller axles.

Paragraph 1, page 54, after the word "contour" add the following:

"A new wheel, to permit a full charge, must have not less than 1½ inches service metal; but, in no case, shall a charge or credit for service metal be made in excess of 1½ inches."

Explanation: To avoid further misunderstanding as to the amount of service metal for which charge or credit can be made, when tread thickness is in excess of 1½ inches above condemning limit.

Last paragraph, add an additional sentence reading as follows:

"Any additional loss of service metal that it is necessary to remove, on account of worn flange or tread, must be borne by car owner."

Explanation: The loss of service metal over and above the amount necessary to remove the flat spot, when such additional loss is necessitated on account of previous wear on tread or flange, should be an owners' responsibility, and the additional sentence that has been added will result in uniform practice and in placing the responsibility where it belongs.

RULE No. 99.

Page 56, change first clause to read:

"If car owner elects on account of improper repairs to remove M. C. B. standard axle from a car, whether or not suitable to the marking on the car, he shall make charge for secondhand axle and allow credit for secondhand axles if they are in good order.

"Axles removed below the journal limits for cars marked capacity, limit weight or maximum weight, as per Rule No. 86, should be credited as scrap when removed."

Explanation: To protect and enforce the use of M. C. B. Standards as laid down in Rule No. 17.

RULE No. 101.

Page 57, change item "Air brake hose, M. C. B. Standard, credit for fittings for same, $0.60" to read "Air brake hose, M. C. B. Standard, *average* credit for fittings for same, $0.60."

Explanation: In accordance with Circular No. 16.

Page 57, change item "Pipe nipple on end of train line, $0.12" to read "Pipe nipple on end of train line, threaded, 12 inches or less in length, $0.12."

Explanation: To clarify the rule.

Page 58, change item "Triple piston and ring, $2.00" to read "Triple *main* piston and ring, $2.00."

Explanation: To correspond with terms used in Westinghouse Catalogue.

Page 58, change item "Triple piston, 'K' type, $3.00" to read "Triple *main* piston, 'K' type, $3.00."

Explanation: To correspond with terms used in Westinghouse Catalogue.

Page 58, change item "Triple piston ring (only) $0.25" to read "Triple *main* piston ring (only) $0.25."

Explanation: To correspond with terms used in Westinghouse Catalogue.

Page 59, change item "Altering height of one end of car, by adjusting center plates or body bolsters, net, $1.40" to read "Altering height of one end of car, by adjusting center plates or body bolsters, net. (This also applies to renewing full length shims,) $1.40."

Explanation: It is frequently necessary to renew shims when height of car is not altered, and it is felt the same price should be used for uniformity in billing.

Page 59, insert the following item: "Box lids, pressed steel, including bolt and spring, all sizes, each, net applied, $0.35."

Explanation: This item is not covered by present rules

Page 59, insert the fololwing items:

"Brake beam, complete, metal, M. C. B. Standard No. 2 (not including safety hanger clip, finger guard clip or finger guard.) new charge $3.50, secondhand charge $2.65, average credit $1.50."

Brake beam, complete, metal, M. C. B. Standard, No. 1 (not including safety hanger clip, finger guard clip or finger guard.) new charge $2.75, secondhand charge $2.05, average credit $1.10."

"Brake beam, complete, metal, Non-M. C. B. Standard, one, renewed, new charge $2.25, secondhand charge $1.70, average credit $0.70."

"Brake beam, metal, average credit for a defective Non-M. C. B. Standard beam removed, when replaced with Non-M. C. B. Standard beam, $0.70."

"Brake beam, metal, scrap credit for a defective Non-M. C. B. Standard beam removed, when replaced with M. C. B. Standard beam, $0.35."

"Brake beam, metal safety hanger clip, one, new, new charge $0.07."

"Brake beam, metal finger guard clip, one, new, new charge $0.07."

"Brake beam, metal finger guard, one, new, new charge $0.05."

Explanation: The average prices for new and secondhand brake beams, as well as the average credit price for same, have been recommended in view of simplifying billing, and to eliminate the necessity for use of reference books in order to determine the proper price to use, which practice prevails at the present time. The prices for new No. 1 and No. 2 beams are based upon

the average prices for these beams as now shown in various reference books, and are considered equitable. The secondhand prices represent 75% of the value of the new beams, and are intended to cover the labor of repairing the beam together with the value of the secondhand and new parts used to put brake beam in serviceable condition. The average credit prices as recommended, when compared with the secondhand prices, represents the average value of the undamaged parts removed at 75% of the value new; or, in other words, the difference between the average credit and secondhand prices represents the average cost of applying the necessary new parts to make a secondhand beam, plus 2 hours labor for repairing the beam. The price of a new Non-M. C. B. Standard beam has been arbitrarily established, and the price is such as will discourage the use of Non-M. C. B. Standard beams.

Page 59, insert the following item: "Cardboard (for defect or destination cards,) complete, applied, each, $0.30."

Explanation: These boards are frequently renewed, but no price is quoted in the present rules.

Page 59, change item "Castings, rough steel, per pound, charge $0.055, credit $0.005" to read "Castings, rough steel, per pound, (not including bolsters and truck sides,) charge $0.055, credit $0.005."

Explanation: Price shown is entirely too high for the large castings mentioned. Furthermore, these castings are generally charged as manufactured articles.

Page 59, change item "Coupler knuckle, one, new, solid, charge $2.25, credit $0.40" to read "Coupler knuckle, one, new, solid, applied, charge $2.25, credit $0.40."

Explanation: To clarify the rule.

Page 59, change item "Coupler knuckle pin, one, new, charge $0.25, credit $0.05" to read "Coupler knuckle pin, one, new, applied, charge $0.25, credit $0.05."

Explanation: To clarify the rule.

Page 59, change item "Coupler lock, one, new, charge $0.60, credit $0.06" to read "Coupler lock, one, new, applied, charge $0.60, credit $0.06."

Explanation: To clarify the rule.

Page 59, insert the following item: "Coupler release clevis chain, applied, net, \$0.06."

Explanation: To clarify the rule.

Page 59, insert the following item: "Coupler release clevis pin, or bolt, applied separately, net, \$0.04."

Explanation: To clarify the rule.

Page 60, insert the following items:

"Door hook, refrigerator car, one, applied, net, \$0.08."

"Door hook staple or eye, one, applied, net, \$0.05."

Explanation: These two items are recommended to cover the refrigerator door hook and door hook staple or eye, for holding doors in open position, with the understanding that the price for the hook includes its fastening to the car, while the staple or eye is that which engages the hook in holding the door open.

Page 61, change item "Lag screws, all sizes, each, renewed, when not used with application of other parts being renewed, net, \$0.03" to read "Lag screws, each, no credit for scrap \$0.01."

Explanation: It is felt that the present net allowance of \$0.03 for labor and material does not cover the average cost of applying lag screws; therefore, a material charge of \$0.01 is recommended and a labor allowance of 1/4 hour has been recommended in Rule 107.

Page 61, change item "Nut-lock, one, applied, net, \$0.03" to read "Nut-lock, each lock, per bolt, \$0.01."

Explanation: The net price of \$0.03 is not considered proper, for the reason that the labor of applying nut-locks is included in the cost of other operations.

Page 61, change item "Pipe 3/8 inch, per foot, \$0.03" to read "Pipe, 3/8 inch, per foot, charge \$0.03, credit \$0.0025."

Explanation: To provide uniform credit price.

Page 61, change item "Pipe, 1 inch, per foot, \$0.05" to read "Pipe, 1 inch, per foot, charge \$0.05, credit \$0.005."

Explanation: To provide uniform credit price.

Page 61, change item "Pipe, 1 1/4 inch, per foot, \$0.07"

to read "Pipe, $1\frac{1}{4}$ inch, per foot, charge \$0.07, credit \$0.01."

Explanation: To provide uniform credit price.

Page 61, change item "Spring cotters or split keys, each, renewed when not used with application of other parts being renewed, net, \$0.03" to read "Spring cotters or split keys, each, renewed when not used with application of other parts being renewed, net, \$0.03.

"Note: No charge to be made for spring cotters or split keys when used in connection with renewal of other parts."

Explanation: To eliminate all misunderstanding in regard to charging for this item, and for the reason that the labor and material charges for other items is sufficient to absorb the cost of cotter keys.

Page 61, insert the following item: "Turnbuckles, all sizes, each, net, \$0.50."

Explanation: To provide a uniform average price.

RULE No. 104.

Paragraph 1, change to read: "Secondhand M. C. B. couplers, friction draft gears, or any parts of these items, may be used in repairs, but must be charged at 75% of value new."

Explanation: Reference to charge for secondhand metal brake beams has been eliminated, as it is proposed to have an average credit price for same. Provision has also been made for the proper charge for secondhand friction draft gears, as this material is not covered in the present rules.

Paragraph 3, line 1: Change words "metal brake beams" to read "friction draft gears."

Explanation: If average credit price for brake beams is adopted, brake beams should be eliminated from this paragraph. Friction draft gears have been added to this paragraph to indicate what credit should be allowed for good parts removed.

RULE No. 107.

Page 63, insert the following item: "Bed iron, for

wooden hopper cars (not including chute planks R. & R.) one, renewed, 2 hours labor, charge $0.56."

Explanation: This item is not covered by the present rules.

Page 64, insert the following item: "Bolster, truck, one, renewed, when one or more truck transoms are renewed, 5 hours labor, charge $1.40."

Explanation: This item is not covered, and the allowance is the same as now shown when bolster is renewed with spring plank.

Page 64, insert the following item: "Bolster, truck, one, renewed, when no bolts or rivets require removal to remove bolster from truck (not including Bettendorf design) 5 hours labor, charge $1.40."

Explanation: Many bolsters are so designed that they can be lifted out of the trucks without disturbing any bolts or rivets and the price of 9 hours now given in the rules is too high for this construction.

Page 64, insert the following item: "Bolt, 'U' or 'J' pipe hanger, one, renewed, ¼ hour labor, charge $0.07."

Explanation: This item is not covered by the present rules.

Page 65, following the item given below:

"Bolts—

Draft timber bolts or carrier iron bolts over 6" long, either or both, at same end of car, renewing:

5 or less, each ½ hour labor, charge $0.14.

6 or more, all, 3 hours labor, charge $0.84."

add the following note:

"Note: Additional labor can be charged for missing nuts, except on bolts that are renewed."

Explanation: It is felt that the present price for draft bolts was not intended to cover the cost of applying nuts that are missing from other draft bolts, but in order to avoid further misunderstanding, this note is recommended.

Page 66, change item as given below:

Bolts—

Center plate bolts and center plate, at one end, renewing, 3 hours labor, charge $0.84."

to read:

Bolts—

Center plate bolts or center plate, either or both, at one end, renewing, 3 hours labor, charge $0.84."

Explanation: To make the meaning of this rule more clear.

Page 64, insert the following item: "Brake beam suspension spring and cap, single or double, either or both, renewed, ¾ hour labor, charge $0.21."

Explanation: Not covered by present rules.

Page 65, insert the following item: "Brake hanger bearing, double, secured to spring plank, one, renewed, 1¾ hours labor, charge $0.49."

Page 65, change item "Brake pin or key bolt, separately, one, renewed, ¼ hour labor, charge $0.07" to read "Brake pin or key bolt (any length,) separately, one, renewed, ¼ hour labor, charge $0.07."

Explanation: The words "any length" have been added, so that this price will include brake hanger key bolts, or other long key bolts, for which some Roads attempt to charge ½ hour.

Page 65, insert the following item: "Brake shaft ratchet wheel, one, renewed, ¾ hour labor, charge $0.21."

Explanation: Not covered by present rules.

Page 64, insert the following item: "Brake beam, outside hung, R. & R. only, one, 1 hour labor, charge $0.28."

"Note: This price must not be used when brake beam is renewed, but is intended for use only when brake beam is R. & R. to make other repairs."

Explanation: It is felt that the present prices for various operations were based upon cost of performing the work on cars with inside hung beams, and as it is an additional expense to remove and replace an outside hung beam, an additional charge for same should be made.

Page 66, insert the following item: "Cap, discharge

valve for tank car, one, renewed, ½ hour labor, charge $0.14."

Explanation: Not covered by the present rules.

Page 66, insert the following item: "Cap, dome for tank car, one, renewed, ¾ hour labor, charge $0.21."

Explanation: Not covered by the present rules.

Page 67, eliminate the following item: "Center plates, one or two, at same end, renewed, 2½ hours labor, charge $0.70."

Explanation: Conflicts with allowance of 3 hours as shown on page 66, for center plate bolts and center plates.

Page 67, change item "Dead-block, wooden, renewed at one end of car, 3½ hours labor, charge $0.98" to read "Dead-block, wood or metal, renewed or R. & R. to renew siding at one end of car, 2½ hours labor, charge $0.70."

Explanation: To make it clear that charge is proper when necessary to remove deadwood to apply siding.

Page 68, insert the following item: "Door cap block or casting, separately, one, renewed, ½ hour labor, charge $0.14."

Explanation: Not covered by the present rules.

Page 68, insert the following item: "Door cap for small end door, 1 hour labor, charge $0.28."

Explanation: Not covered by the present rules.

Page 68, insert the following item: "Door end, old, rehanging, on automobile car, 3 hours labor, charge $0.84."

Explanation: Same labor as allowed for refrigerator side doors.

Page 68, change item "Door hanger or roller, either or both, renewed, 1 hour labor, charge $0.28" to read "Door hanger or roller, either or both, renewed, except when door is rehung, 1 hour labor, charge $0.28."

Explanation: To avoid confusion in billing.

Page 68, change item "Door hinge, one, renewed, 1 hour labor, charge $0.28" to read "Door hinge, one, renewed, except when door is rehung, 1 hour labor, charge $0.28."

Explanation: To avoid confusion in billing.

Page 68, change item "Door rod, lock, one, renewed, 1½ hours labor, charge $0.42" to read "Door rod (lock,) one, renewed, not including door rehung, 1½ hours labor, charge $0.42."

Explanation: To avoid confusion in billing.

Page 68, change item "Door rod shoe, only, one, renewed, ½ hour labor, charge $0.14" to read "Door rod shoe, only, one, renewed, except when door is rehung, ½ hour labor, charge $0.14."

Explanation: To avoid confusion in billing.

Page 68, change item "Door track, top or bottom, one, renewed, 2 hours labor, charge $0.56" to read "Door track, top or bottom, one, renewed, not including door rehung, 2 hours labor, charge $0.56."

Explanation: To avoid confusion in billing.

Page 69, change item "Draft timbers tightened, one end; no additional labor for tightening when draft bolt or bolts are renewed, ½ hour labor, charge $0.14" to read "Draft timbers tightened, each; no additional labor for tightening when draft bolt or bolts are renewed in same timber, ¼ hour labor, charge $0.07.

"Note: Additional labor can be charged for missing nuts."

Explanation: The proposed wording will permit a labor charge for tightening one draft timber when draft bolts are applied to the opposite timber at same end of car, and will also permit an additional labor charge for the application of missing nuts.

Page 69, insert the following items:

"Drop door hinge, one, renewed, 1 hour labor, charge $0.28."

"Drop door reach or connecting rod, one, R. & R. or renewed, ½ hour labor, charge $0.14."

"Drop door reach or connecting rod, blacksmith labor repairing, ¾ hour labor, charge $0.21."

"Facia, renailing, one or two ends, or one side, ¼ hour labor, charge $0.07."

Explanation: Not covered by the present rules.

Page 69, change item "Flooring boards renewed, per lineal foot, \$0.22" to read "Flooring boards renewed (full length boards or patched,) per lineal foot, \$0.22."

Explanation: It is felt this price should apply in repairing as well as renewing entire floor.

Page 69, insert the following items:

"Flooring, short, over center sills, between drop doors, per lineal foot, \$0.04."

"Follower guide or rest plate, steel cars, tightened, per end, ¼ hour labor, charge \$0.07."

Explanation: Not covered by the present rules.

Page 70, insert the following items:

"Key for center pin, separtely, one, renewed, ¼ hour labor, charge \$0.07."

"Lag screws, one, renewed, ¼ hour labor, charge \$0.07."

"Nuts, tightening, except where included in cost of other operations, each, charge \$0.01."

"Post, center door, automobile cars, one, R. & R. to repair door (when attached to door,) 1½ hours labor, charge \$0.42."

Explanation: Not covered by the present rules.

Page 71, change item "Renailing roofing and siding, per lineal foot, \$0.015" to read "Renailing roofing or siding, per lineal foot, \$0.015."

Explanation: To make meaning of rule clear.

Page 71, insert the following item: "Renailing lining, per end or side section, from door to end of car, either above or below belt rail, \$0.05."

Explanation: This item is not covered by the present rules, and the per section basis will avoid any misunderstanding as to measurement, that would obtain if price were shown on a lineal foot basis.

Page 71, insert the following item: "Rod, transverse tie, one applied, first application, including drawing sides of car together, 2 hours labor, charge \$0.56."

Explanation: To cover the application of temporary tie rods, account sides of car spread.

Page 71, insert the following item: "Rod, transverse tie, one, renewed, (except first application,) ¾ hour, labor, charge $0.21."

Explanation: Not covered by the present rules.

Page 71, insert the following item: "Rod, longitudinal tie, full length, on hopper cars, one, renewed, 1¾ hours labor, charge $0.49."

Explanation: Proposed price corresponds with that allowed for a one-section body truss rod.

Page 71, insert the following items:

"Running board, latitudinal, secured with bolts or screws, renewed, per single board, ¾ hour labor, charge $0.21."

"Running board, latitudinal, one renewed, complete, 4½ hours labor, charge $1.26."

Explanation: Not covered by the present rules.

Page 72, insert the following item: "Siding, short, above or below door openings, including fixtures R. & R., renewed, per lineal foot, $0.07."

Explanation: Not covered by the present rules.

Page 72, insert the following item: "Sill, short sub, bolted to side of full length single center sill, and extending from end sill to a point back of body bolster, and to which draft timbers are bolted.

"One renewed, 18½ hours labor, charge $5.18.

"Two renewed, same end, 23 hours labor, charge $6.44."

Explanation: This item is necessary to cover certain foreign cars having the short sub-sills referred to. The charge is based on the allowance for splicing center sills with the reduction of 3½ hours on each, account of slab plank and framing of old sill not being required. The proposed charge corresponds with the amount that certain car owners have agreed to accept for this work.

Page 75, insert the following item: "Truck, R. & R., when necessary in connection with repairs made on a rivet basis, 1 hour labor, charge $0.28."

Explanation: This item is not covered in the present rules, but charge for same is proper in connection with repairs that are handled on a rivet basis.

Page 76, add the following paragraph after the schedule of prices for dismantling cars, Rule No. 107: "Deduct $3.00 from above prices when trucks are not dismantled."

Explanation: Rules should provide a price for dismantling body only, since there are numerous cases where only body is dismantled and trucks returned to owner.

RULE No. 109.

Paragraph 2, change to read: "When one or more carrier iron bolts over 6 inches long are replaced, and coupler at same end of car is replaced, the regular labor charge may be made for applying the carrier iron bolts, in addition to charge for replacing coupler."

Explanation: The charge for carrier iron bolts is now on a per bolt basis, and the overlapping labor should not be considered.

Paragraphs 3 and 4, eliminate these paragraphs and substitute the following: "No additional labor to be charged for applying carrier iron bolts when one or both draft timbers are renewed at same end of car."

Explanation: The labor allowance for draft timbers is sufficient to cover the renewal of carrier iron bolts.

RULE No. 111.

Page 78, change item "Angle cock, R. & R., $0.08" to read "Angle cock, R. & R., (including air hose, R. & R.) $0.08."

Explanation: Change made to show details of price.

Page 78, change item "Angle cock handle, renewed, $0.04" to read "Angle cock handle, renewed, (including angle cock and air hose, R. & R.) $0.12."

Explanation: It is necessary to remove and replace angle cock when renewing handle, in order to avoid damage to angle cock when drifting out riveted pin. The details of the operation are shown, and necessary price recommended.

Page 78, change item "Angle cock, grinding in, R. &

R, $0.28" to read "Angle cock, R. & R., and grinding in, (including air hose, R. & R.) $0.28."

Explanation: Wording changed to include details of operation.

Page 78, change item "Check valve case, spring, gasket, or all, R. & R. $0.10."

Details	Cents
"Disconnecting union	3
"Check valve case (2 cap screws)	2
"Emergency valve seat	5
Total	10"

to read "Check valve case gasket, renewed, $0.12.

Details	Cents
"Disconnecting union	3
"Check valve case (4 nuts, ½ inch, 1 cent each)	4
"Emergency valve seat	5
Total	12"

Explanation: The check valve case and spring were eliminated, as these items are not renewed except in connection with other repairs to triple valve.

Page 79, change item "Cut-out cock, R. & R. $0.09" to read "Cut-out cock, R. & R., charge for necessary connections at 3 cents for each connection, R. & R. $——."

Explanation: The price of $0.09 has been eliminated and the wording changed, as the cost of this operation is dependent entirely upon the number of connections necessary to R. & R.

Page 79, change item "Cut-out cock, grinding in, R. & R. $0.30" to read "Cut-out cock, grinding in, (not including R. & R.) $0.20."

Explanation: Price and wording changed to permit charging for removing and replacing cut-out cock on a connection basis.

Page 79, change item "Cut-out cock handle, renewed, $0.04" to read "Cut-out cock handle, renewed, (not including connections necessary to R. & R. cut-out cock) $0.04."

Explanation: Wording changed to indicate that it is

necessary to R. & R. cut-out cock in order to properly perform this work, and that an additional charge can be made for necessary connections.

Page 79, insert the following item: "Cylinder, detached type, renewed, $0.72.

Details	Cents
"Push rod (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"Cylinder head, R. & R. (4 nuts, ½ inch, 1 cent each)	4
"Loosening cylinder from car (6 nuts, ⅝ inch, 2 cents each)	12
"Cylinder, R. & R.	6
"3 pipe connections	9
"Pressure head, R. & R. (7 nuts, ½ inch, 1 cent each)	7
"Cleaning, oiling, testing and stenciling	29
Total	72"

Explanation: This additional item together with details shown, is necessary for the reason that the price of $0.23 now shown in the rules for "Cylinder, R. & R." does not properly provide for the renewal of cylinder. The detail item "Cylinder, R. & R., 6 cents" has been added in addition to the allowance for removing the 6—⅝ inch nuts which secure the cylinder to the car, for the reason that the allowance on a nut basis only is not sufficient to cover the actual cost of removing and replacing the cylinder.

Page 79, change item "Cylinder, R. & R., detachable, $0.23" to read "Cylinder, detached type, R. & R., (to make other repairs) $0.30.

Details	Cents
"Push rod (1 connecting pin)	3
"Loosening cylinder from car (6 nuts, ⅝ inch, 2 cents each)	12
"3 pipe connections	9
"Cylinder, R. & R.	6
Total	30"

Explanation: The increase in price in accordance with details shown is necessary to properly cover the operation. See explanation, Item above, for the detail "Cylinder R. & R., 6 cents."

Page 79, insert the following item: "Cylinder, combined type, renewed, $0.83.

Details	Cents
"Push rod (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"Cylinder head, R. & R. (4 nuts, ½ inch, 1 cent each)	4
"Disconnecting cylinder and reservoir, (7 nuts, ½ inch, 1 cent each)	7
"Loosening cylinder and reservoir from car (8 nuts, ⅝ inch, 2 cents each)	16
"Cylinder and reservoir, R. & R.	12
"2 release rods, R. & R. (2 spring cotters)	4
"2 pipe connections	6
"Cleaning, oiling, testing and stenciling	29
Total	.83"

"Note: Additional charge to be made for release valve R. & R., and release valve extension pipe connections when same are necessary."

Explanation: The present price of $0.30 for cylinder R. & R., combined type, does not cover the necessary operations when cylinder is renewed. The detail item "Cylinder and reservoir, R. & R., 12 cents" has been added, for the reason that an allowance on a nut basis only, is not sufficient to cover the actual cost of removing and replacing cylinder and reservoir.

Page 79, eliminate the following item, and details shown in connection with same: "Cylinder, R. & R., combined type, $0.30.

Details	Cents
"Push rod (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"Cylinder head, R. & R. (4 nuts, ½ inch, 1 cent each)	4

"Disconnecting cylinder from reservoir (7 nuts, ½ inch, 1 cent each)	7
"Reclamping cylinder piston (1 cap screw)	2
"Removing cylinder from car (6 nuts, ⅝ inch, 2 cents each)	12
Total	30"

Explanation: This item should be eliminated, as the removing and replacing of cylinder, combined type, is covered by the item "Cylinder and reservoir, combined type, R. & R.," and as the price of $0.30 does not cover cost of renewing a cylinder of the combined type, a new item for this operation has been shown above.

Page 80, change item "Cylinder and reservoir, R. & R., $0.41.

Details	Cents
"Removing push rod (1 connecting pin)	3
"Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
"Removing cylinder from car (6 nuts, ⅝ inch, 2 cents each)	12
"Removing reservoir from car (2 nuts, ⅝ inch, 2 cents each)	4
"Removing release rods (2 spring cotters)	4
"Removing release valve	2
"Removing 2 plugs	2
"Removing triple (2 nuts, ⅝ inch, 2 cents each)	4
"Disconnecting train pipe union	3
"Disconnecting retaining pipe union	3
Total	41"

to read "Cylinder and reservoir, combined type, R. & R., to make other repairs, $0.41.

Details	Cents
"Push rod (1 connecting pin)	3
"2 release valve rods (2 spring cotters)	4
"2 pipe connections	6

"Loosening cylinder and reservoir from car (8 nuts, 5/8 inch, 2 cents each) 16
"Cylinder and reservoir, R. & R. 12

Total .... 41"

"Note: Additional charge to be made for release valve R. & R., and release valve extension pipe connections when same are necessary."

Explanation: The present price and details shown in the rule was intended to cover the cost of renewing cylinder and reservoir, but as the operations shown do not properly cover the renewal of these parts, this item has been reworded, and new details shown to cover the removing and replacing when same is necessary to make other repairs. See explanation, Item No. 10, for the detail charge of "Cylinder and Reservoir, R. & R., 12 cents."

Page 80, insert the following item: "Cylinder and reservoir, combined type, renewed, both at same time, $0.91.

Details	Cents
"Push rod (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"Cylinder head, R. & R. (4 nuts, ½ inch, 1 cent each)	4
"Disconnecting cylinder and reservoir, (7 nuts, ½ inch, 1 cent each)	7
"Loosening cylinder and reservoir from car (8 nuts, 5/8 inch, 2 cents each)	16
"Cylinder and reservoir, R. & R.	12
"2 release rods (2 spring cotters)	4
"Release valve, R. & R.	2
"2 pipe connections	6
"Triple valve, R. & R. (3 nuts, 5/8 inch, 2 cents each)	6
"Cleaning, oiling, testing and stenciling	29
Total	91"

"Note: Additional charge to be made for release valve R. & R., and release valve extension pipe connections when same are necessary."

Explanation: This item, together with details, is necessary, as the present rules do not provide for same. See explanation for Item No. 1, Sheet No. 30, for the detail charge of "Cylinder and Reservoir, R. & R., 12 cents."

Page 80, change item "Cylinder release spring, R. & R., $0.11" to read "Cylinder release spring renewed, when piston is not removed for other purposes, $0.11."

Explanation: Wording changed for the reason that this price is only necessary when spring is renewed, which renewal is usually made when piston is removed for other repairs, and the details of the latter item is included in other operations.

Page 81, change item "Cylinder gasket, R. & R., $0.25.

Details	Cents
"Disconnecting triple union	3
"Disconnecting retaining pipe union	3
"Disconnecting reservoir block (2 nuts, 5/8 inch, 2 cents each)	4
"Disconnecting reservoir from cylinder (7 nuts, 1/2 inch, 1 cent each)	7
"Removing push rod (connecting pin)	3
"Clamping cylinder piston	1
"Removing release rod (2 spring cotters).......	4
Total	25"

to read "Cylinder gasket, combined type, renewed, $0.50."

Details	Cents
"Push rod (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"2 release rods, R. & R. (2 spring cotters)......	4
"2 pipe connections	6
"Loosening cylinder and reservoir from car (8 nuts, 5/8 inch, 2 cents each)	16
"Cylinder and reservoir, R. & R.	12
"Disconnecting cylinder from reservoir (7 nuts, 1/2 inch, 1 cent each)	7
Total	50"

Explanation: The additional details and increased price is necessary to properly cover the cost of this operation. See explanation for Item No. 1, Sheet No. 30, for the detail charge of "Cylinder and Reservoir, R. & R., 12 cents."

Page 81, insert the following item: "Cylinder gasket, detached type, renewed, $0.18.

Details	Cents
"Clamping piston (1 cap screw)	2
"3 pipe connections	9
"Pressure head, R. & R. (7 nuts, ½ inch, 1 cent each)	7
Total	18"

Explanation: This operation is not covered in the present rules.

Page 81, eliminate the following item; also, details for same:

"Emergency valve piston, R. & R., $0.10.

Details	Cents
"Disconnecting union	3
"Removing check valve case (2 cap screws).....	2
"Removing emergency valve seat	5
Total	10"

Explanation: This operation is only performed in connection with other repairs to triple valve, and is absorbed in other prices.

Page 81, eliminate item "Emergency valve seat, R. & R., $0.10."

Explanation: This operation is only performed in connection with other repairs to triple valve, and is absorbed in other prices.

Page 81, change item "Emergency valve rubber seat, R. & R., $0.10," to read "Emergency valve rubber seat, renewed, when triple valve is not removed for other repairs, $0.10." Eliminate details shown on page 82.

Explanation: Wording changed to avoid improper use of this price.

Page 82, insert the following item: "Emergency valve rubber seat, renewed, when triple valve is removed for other repairs, $0.05."

Explanation: This item is necessary, as the present price of $0.10 is excessive for renewing rubber seat, when triple valve is receiving other repairs.

Page 82, change item "Cylinder piston packing, R. & R., $0.13.

Details	Cents
"Removing push rod (1 connecting pin)	3
"Clamping cylinder piston (1 cap screw)	2
"Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
"Removing leather packing (4 nuts, ½ inch, 1 cent each)	4
Total	13"

to read "Cylinder piston packing leather removed when piston is not removed for other repairs, $0.42.

Details	Cents
"Push rod, R. & R. (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
"Removing piston packing leather (4 nuts, ½ inch, 1 cent each)	4
"Cylinder cleaned, oiled, tested and stencilled....	29
Total	42"

Explanation: Price has been changed to include cleaning, oiling, testing and stenciling cylinder, for the reason that this work should be done when a packing leather is renewed, regardless of date of previous cleaning.

Page 82, insert the following item: "Cylinder piston packing leather renewed, when piston is removed for other work, $0.04.

Details	Cents
"4 nuts, ½ inch, 1 cent each..................	4"

Explanation: Not covered by the present rules.

Page 82, change item "Cylinder piston, R. & R., $0.15.

Details	Cents
"Removing push rod (1 connecting pin)	3
"Clamping cylinder piston (1 cap screw)	2
"Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
"Removing leather packing (4 nuts, ½ inch, 1 cent each)	4
"Reclamping cylinder piston (1 cap screw)	2
Total	15"

to read "Cylinder piston renewed, when not removed for other repairs, $0.31.

Details	Cents
"Push rod, R. & R. (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
"Packing leather, R. & R. (4 nuts, ½ inch, 1 cent each)	4
"Reclamping piston (1 cap screw)	2
"Piston rod, R. & R. (4 rivets, 4 cents each)	16
Total	31"

Explanation: Wording changed, as this item is intended to cover the renewal of cylinder piston, when it is not removed for other repairs. The additional detail "4 rivets, 16 cents" has been added, as this operation is necessary for the renewal of piston.

Page 82, insert the following item: "Cylinder piston, R. & R. for other repairs. (This price is not to be used when the removal of piston is included in cost of other specified operations) $0.09.

Details	Cents
"Push rod, R. & R. (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"Removing cylinder (4 nuts, ½ inch, 1 cent each)	4
Total	9"

Explanation: This additional item has been added in order to provide a price for the removing and replacing of cylinder piston, for the purpose of making repairs that are not covered by other specific operations; as, for instance, renewal or tightening of piston follower bolts.

Page 82, insert the following item: "Cylinder piston renewed, when piston is removed for other repairs, $0.22.

Details	Cents
"Packing leather R. & R. (4 nuts, ½ inch, 1 cent each)	4
"Reclamping piston (1 cap screw)	2
"Piston rod, R. & R. (4 rivets, 4 cents each)	16
Total	22"

Explanation: Not covered by the present rules.

Page 82, change item "Dirt collector in branch pipe cleaned, drained and stencilled, $0.05" to read "Dirt collector in branch pipe drained, cleaned and stencilled, $0.05."

Explanation: Wording changed to cover operations in the order in which they are performed.

Page 83, change item "Oil plugs, R. & R., each, $0.02" to read "Reservoir plugs, R. & R., each, $0.02."

Explanation: "Oil plugs" not proper term.

Page 83, change item "Packing leather expander, renewed, (see cylinder piston) $0.07" to read "Packing leather expander, renewed, (see cylinder piston, R. & R., for details,) $0.09."

Explanation: Wording and price changed to conform to previous recommendations, shown in Item No. 1, Page No. 36.

Page 83, change item "Pipe, train or branch, R. & R., for each connection made, $0.03" to read "Pipe, disconnected and connected, or only connected, each connection, $0.03."

Explanation: Wording changed to make it clear that price applies to all piping on a car.

Page 83, change item "Release valve, renewed, $0.06" to read "Release valve, R. & R., or renewed, $0.06."

Explanation: Wording changed to cover removing and replacing, in addition to renewal.

Page 83, change item "Release valve, removed, repaired and replaced (R. & R. 4 cents) $0.09" to read "Release valve, removed, repaired and replaced (R. & R. 6 cents) $0.13."

Explanation: Present price will not cover average cost of repairing.

Page 83, change item "Reservoir, R. & R., $0.29.

Details	Cents
"Removing from car (2 nuts, 5/8 inch 2 cents each)	4
"Disconnecting from cylinder (7 nuts, 1/2 inch, 1 cent each)	7
"Removing release rods (2 spring cotters)	4
"Removing release valve	2
"Removing 2 plugs	2
"Removing triple valve (2 nuts, 5/8 inch, 2 cents each)	4
"Disconnecting union	3
"Disconnecting union, retaining pipe	3
Total	29"

to read "Reservoir, combined type, renewed, $0.61.

Details	Cents
"Push rod, R. & R. (1 connecting pin)	3
"Clamping piston (1 cap screw)	2
"2 release valve rods, R. & R. (2 spring cotters)	4
"2 pipe connections	6
"Release valve, R. & R.	2
"Triple valve, R. & R. (3 nuts, 5/8 inch, 2 cents each)	6
"Cylinder and reservoir disconnected (8 nuts, 1/2 inch, 1 cent each)	8
"Loosening cylinder and reservoir from car (8 nuts, 5/8 inch, 2 cents each)	16

"Cylinder and reservoir, R. & R.	12
"Reservoir stencilled	2
Total	61"

Explanation: The present price was evidently intended to cover the renewal, as well as removing and replacing a reservoir of the combined type. The price, however, does not cover actual cost of renewal. The revised details show all the necessary operations. The removing and replacing of reservoir was covered by the previous item "Cylinder and reservoir, combined type, R. & R., to make other repairs." See explanation, Item No. 1, Sheet No. 30, for the detail "Cylinder and reservoir, R. & R., 12 cents."

Page 84, insert the following item: "Reservoir, detached type, renewed, $0.43.

Details	Cents
"5 pipe connections	15
"2 release rods, R. & R. (2 spring cotters)	4
"Release valve, R. & R.	2
"Triple valve, R. & R. (3 nuts, ⅝ inch, 2 cents each)	6
"Loosening reservoir from car (4 nuts, ⅝ inch, 2 cents each)	8
"Reservoir, R. & R.	6
"Reservoir stencilled	2
Total	43"

Explanation: This operation is not covered in the present rules. See explanation, Item No. 2, Sheet No. 29, for the detail "Reservoir R. & R., 6 cents."

Page 84, insert the following item. "Reservoir, detached type, R. & R., to make other repairs, $0.27.

Details	Cents
"3 pipe connections	9
"2 release rods, R. & R. (2 spring cotters)	4
"Loosening reservoir from car (4 nuts, ⅝ inch, 2 cents each)	8
"Reservoir R. & R.	6
Total	27"

Explanation: This operation is not covered in the present rules. See explanation, Item No. 2, Sheet No. 29, for the detail "Reservoir R. & R., 6 cents."

Page 84, eliminate the following items:

"Removing cylinder cap (3 nuts, ½ inch, 1 cent each) $0.03."

"Removing slide valve (3 nuts, ½ inch, 1 cent each) $0.03."

Explanation: These operations are included in price for triple valve cleaned and oiled.

Page 84, change item "Retaining valve, R. & R. (2 lag screws, 2 cents; valve, 3 cents) $0.05" to read "Retaining valve, R. & R. (2 lag screws or 2 nuts, 2 cents; valve, R. & R., 3 cents) $0.05."

Explanation: Wording changed to cover retaining valve, secured by bolts.

Page 84, insert the following item: "Retaining valve, cleaned on car, $0.05."

Explanation: This operation should be covered by rules.

Page 84, change item "Slide valve, removed, ground in, and replaced, $0.33" to read "Slide or exhaust valve, ground in, $0.33."

Explanation: Reference to removing and replacing slide valve has been omitted, as the removing and replacing is provided for in the cost of cleaning and oiling triple valve, and the price of $0.33 should only cover grinding in.

Page 84, eliminate the following item; also, details: "Slide valve spring, R. & R., $0.06.

Details	Cents
"Cylinder cap (3 cap screws)	2
"Removing riveted pin	4
Total	6"

Explanation: This item is unnecessary, and it is only performed when triple valve is being repaired, and included in the price for this operation.

Page 84, change item "Slide valve spring, R. & R., removing riveted pin, $0.04" to read "Slide valve spring, renewed, when triple valve is being repaired, removing riveted pin, $0.04."

Explanation: Wording changed to show when this price is to be used.

Page 84, eliminate the following item: "Strainer, renewed (disconnecting union) $0.03."

Explanation: No additional labor is involved to renew strainer, as it is only renewed in connection with other operations.

Page 84, change item "Triple cylinder bushing, reground or refitted, $1.12" to read "Triple cylinder bushing, renewed, $1.12."

Explanation: Wording changed, for the reason that this price is intended to cover the renewal of bushing and should not be used for re-grinding old bushing.

Page 85, insert the following item: "Triple cylinder bushing, re-ground, $0.50."

Explanation: This operation is not properly covered in the present rules.

Page 85, eliminate the following items:

"Triple cylinder cap, R. & R. (3 nuts, ½ inch, 1 cent each) $0.03."

"Triple cylinder cap gasket, renewed (3 nuts, ½ inch, 1 cent each; gasket, 2 cents) $0.05."

Explanation: These operations are absorbed in price for cleaning and repairing triple valves.

Page 85, change item "Triple piston packing ring renewed, $0.22" to read "Triple main piston ring renewed, $0.35."

Explanation: The term "main piston" is used to conform to term used by manufacturers. Price was increased for the reason that the present price of $0.22 shown does not cover the actual cost to perform this operation.

Page 85, change item "Triple valve removed, cleaned, oiled, tested and stencilled, $0.45.

Details	Cents
"Train pipe union, disconnected	3
"Retaining pipe union, disconnected	3
"Removing triple (2 nuts, 5/8 inch, 2 cents each)	4
"Check valve case (2 cap screws)............	2
"Emegency valve seats	5
"Cylinder cap (3 bolts)	3
"Cleaning, testing and stenciling	25
Total	45"

to read "Triple valve removed, cleaned, oiled, tested and stencilled, $0.52.

Details	Cents
"3 pipe connections	9
"Triple valve, R. & R. (3 nuts, 5/8 inch, 2 cents each)	6
"Check valve case, R. & R. (4 nuts, 1/2 inch, 1 cent each)	4
"Emergency valve seat, R. & R.	5
"Cylinder cap, R. & R. (3 nuts, 1/2 inch, 1 cent each)	3
"Cleaning, lubricating, testing and stenciling	25
Total	52"

Explanation: Detail prices changed to cover 10 inch equipment. Also, one additional pipe connection added to provide for removing retaining pipe nipple from triple valve. The revised price more nearly covers the average cost for this work.

Page 85, change item "Triple valve gasket, renewed, $0.10.

"Note: Not to be allowed when triple valve is oiled, cleaned or removed for other repairs.

Details	Cents
"Disconnecting branch pipe union	3
"Disconnecting retaining pipe union	3
"Removing triple (2 nuts, 5/8 inch, 2 cents each)	4
Total	10"

to read "Triple valve gasket, renewed, when triple valve is not removed for cleaning or repairs, $0.12."

Details	Cents
"2 pipe connections	6
"Triple valve, R. & R. (3 nuts, 5/8 inch, 2 cents each)	6
Total	12"

Explanation: Price changed to cover 10 inch equipment. The use of this price for all types of valves will more nearly cover actual cost.

Page 85, insert the following item: "Testing air (after repairs,) $0.05.

"Note: This price can be charged as a separate operation when necessary to test air after repairs to air brake parts, pipe or pipe fittings, except where this item is specifically mentioned in the details of other operations, as in the case of cylinder or triple valve cleaned, oiled and tested."

Explanation: It is felt that this operation should not be eliminated, as recommended by the Arbitration Committee in Circular No. 9, but should be removed from table of basic units, and shown as a separate item, for the reason that the testing of air is a necessary operation and must be paid for, and is not included in the details of any operations with the exception of cylinder and triple valve cleaned, oiled and tested. The explanatory note shown under this item should make its use clear.

Page 85, eliminate the following item: "Union, disconnected and connected, $0.03."

Explanation: This item is covered by the item "Train or branch pipe, disconnected and connected, or only connected, each connection, $0.03."

Page 85, insert the following item: "Threads on pipe, cutting, per connection, $0.05."

Explanation: This operation should be eliminated from the table of basic units, and shown as a separate item, for the reason that it is not included in any of

the combination prices for other operations, and is always shown as a separate item.

Page 86, change item:

"Basic Units

"Cap Screws or bolts, R. & R., 1 or more, $0.02."

to read:

"Basic Units

"Cap screws, R. & R., each, $0.02."

Explanation: Reference to bolts is eliminated, for the reason that it conflicts with the allowance of 1 cent for ½ inch nuts, and 2 cents for ⅝ inch nuts; the latter price being used in determining the cost for various operations. Also, the price of 2 cents each for cap screws is more equitable than the present price of 2 cents, for 1 or more cap screws.

Page 86, eliminate the following item: "Graduating stem nut, R. & R., $0.02."

Explanation: Included in cost of cleaning and repairing triple valve.

Page 86, change item "Plugs, oil, R. & R., each, $0.01" to read "Reservoir plugs, R. & R., each, $0.01."

Explanation: "Oil plugs" not proper term.

Page 86, eliminate the following item: "Testing air (after repairs) $0.05."

Explanation: Should be shown as separate item, as recommended.

Page 86, eliminate the following item: "Threads on pipe, cutting, per coupling, $0.05."

Explanation: Should be shown as separate item, as recommended.

Page 86, change item: "Train or branch pipe, disconnected and connected, or only connected, each connection, $0.03" to read "Pipe disconnected and connected, or only connected, each connection, $0.03."

Explanation: Wording changed to make it clear that price applies to all piping on a car.

Page 86, insert the following item: "Stenciling, $0.02."

Explanation: This detail is not now shown under basic units, but has been included in the recommendations for costs of certain operations.

RULE No. 115.

Paragraph 2, line 1, substitute "60,000 pounds" for "50,000 pounds."

Explanation: In view of the fact that many railroads are disposing of 60,000 pounds capacity cars and, therefore, the trucks from same are only of scrap valve, with the exception of good metal brake beams and wheels, it is considered advisable to include 60,000 pounds capacity trucks in this rule.

RULE No. 116.

Change the price of $27.50, allowance for 8 inch air brake equipment, to $15.00.

Explanation: 8 inch air brake equipment is practically obsolete. All roads have a surplus of this material on hand and its practical value is scrap.

Prices for bodies of eight-wheel steel cars; the following modifications in the description of these cars are recommended:

Item 1, change to read "Box, wooden body, metal underframe, 50 tons capacity, 38 feet 6 inches or over, but less than 40 feet, over end sills, $825.00."

Explanation: To avoid confliction with Item No. 3.

Item 2, change to read "Box, wooden body, metal underframe, 50 tons capacity, 36 feet long or over, but less than 38 feet 6 inches, over end sills, $740.00."

Explanation: To avoid confliction with Item No. 1.

Item 3, change to read "Box, wooden body, metal underframe, 50 tons capacity and over, 40 feet long or over, but less than 46 feet, over end sills, $850.00."

Explanation: To cover cars over 40 feet long.

Item 4, change to read "Box, wooden body, metal underframe, 30 tons capacity, and over 36 feet long over end sills, $725.00."

Explanation: Comma (,) omitted after word "over"

in the second line, in accordance with Circular No. 16.

Item 5, change to read "Box, wooden body, metal underframe, 40 tons capacity and over, but less than 50 tons capacity, 36 feet long and over, but less than 38 feet long, over end sills, $730.00."

Explanation: To avoid confliction with Item No. 6.

Item 6, change to read "Box, wooden body, metal underframe, 40 tons capacity, but less than 50 tons capacity, 38 feet long but less than 40 feet long, over end sills, $775.00."

Explanation: To avoid confliction with Item No. 2 and 7.

Item 7, change to read "Box, wooden body, metal underframe, 40 tons capacity, but less than 50 tons capacity, 40 feet long or over, but less than 46 feet, over end sills, $800.00."

Explanation: To avoid confliction with Item No. 3.

Items 8, 9, 10 and 11, eliminate these items and substitute the following: "Box, all-steel, any capacity or length, $0.0325 per pound."

Explanation: The present detailed description is unnecessary and can be covered by the proposed general description, as the price for all all-steel box cars is on a per pound basis.

Items 12, 13, 14, 15 and 16, eliminate these items and substitute the following: "Flat, wooden floor, metal underframe, any capacity or length, $0.0325 per pound."

Explanation: The detailed descriptions as shown are unnecessary as the general description recommended will answer for all of these items, the price being on a per pound basis.

Items 17, 18, 19, 20, 21, 22, 23, 24, 29, 30, 31, 32, 43 and 44, eliminate these items and substitute the following: "Gondola, all-steel, any capacity or length, having either solid, drop or hopper bottom or self-clearing by floor dropping on side, $0.0325 per pound."

Explanation: Detailed descriptions are unnecessary, as the price in all of these cases is on a per pound basis.

Item 33, eliminate this item.

Explanation: This item conflicts with Items Nos. 25, 26, 27 and 28, for the reason that the latter appear to cover all gondola cars having wooden body, metal underframe and solid bottoms, on a capacity basis, whereas Items Nos. 33 and 34 do not specify any capacity, but instead classify these cars according to length over end sills.

Items 35, 36, 37, 38, 40, 41 and 42, eliminate these items and substitute the following: "Hopper, all-steel (including coke cars,) self-clearing, any capacity or length, $0.0325 per pound."

Explanation: Detailed description is unnecessary, as all of the cars covered by the items referred to are to be settled for on per pound basis.

Items 45 and 46, these two items should follow the other items covering gondola cars.

Explanation: For better reference.

Insert the following item: "Stock, wooden body, metal underframe, 50 tons capacity, 36 feet long or over, over end sill, $775.00."

Explanation: Present rules do not provide a price for a 50 ton capacity car of this description.

RULE No. 117.

Paragraph 2, change to read: "In the case of all-steel car bodies or car bodies with steel underframes and steel superstructure frames, the depreciation shall be figured at 5% per annum. This includes gondola cars with steel underframes, steel side and corner stakes."

Explanation: The depreciation of car bodies with steel underframes and steel superstructure frames is not covered by the present rules, and it is felt that they should be subject to 5% depreciation the same as in the case of all-steel car bodies.

Paragraph 3, after word "underframes" in second line, add the words "and wooden superstructure."

Explanation: To avoid confliction with Paragraph 2, as revised.

Paragraph 5, change to read: "Depreciation of trucks, other than all-metal shall be figured at 7% per annum."

Explanation: The present depreciated value is far in excess of the actual scrap value, and it is felt that all trucks other than all-metal, and which are usually of 60,000 pounds capacity and under, should be depreciated to a value that will compare more favorably with the scrap value of the trucks.

Last paragraph, change price of $27.50 to read $15.00.

Explanation: In accordance with recommendation for Rule No. 116.

RULE No. 120.

Lines 13 and 16, change the word "rebuild" to read "repair." Also, change the word "rebuilding" in the nineteenth line to "repairing."

Explanation: This is in accordance with Circular No. 9.

Add the following note under Rule No. 120:

> "Note: Request on owners for disposition of cars under Rule No. 120, must not be made unless the estimated labor cost to repair amounts to more than 10% of the list value of the bodies only, as given in Rule No. 116. No additions to be made for the value of the air brakes, metal bolsters, sills, etc. The labor cost to repair must be based on M. C. B. labor costs, as given in Rules Nos. 101 and 107."

Explanation: This recommendation is in accordance with Circular No. 9, except that reference is made to cover shipments by express, and will remove any doubt as to how bills should be rendered for freight or express charges.

Explanation: This is, also, in accordance with Circular No. 9.

RULE No. 122.

Lines 4 and 7, after the word "reclaim" add the words "from its own revenue freight account."

Explanation: To make clear the intent of the rule as explained in Circular No. 9.

Page 97, continuation of last paragraph on page 96, add an additional sentence after the word "line" in the last line, as follows: "A separte bill, with copy of freight or express bill attached, should be rendered for the freight or express charges, showing reference to bill covering repairs."

Paragraph 3, change the word "should" in second line, to "must."

Explanation: In order to make the rule more imperative and avoid unnecessary per diem charges accruing against road making repairs, on account of length of time elapsing before receipt of material when shipped by freight.

Wheel and axle billing repair cards, referred to in Rules Nos. 7, 8 and 96, to be as follows:

M. C. B. ASSOCIATION---BILLING REPAIR CARD---(Wheels and Axles)

(NAME OF RAILROAD)

WHEELS AND AXLE REMOVED						WHEELS AND AXLE APPLIED					
MAKER	Ry. Co's Initials on Wheel	WHEEL NO. DATE CAST	Service Metal Before Turning	Service Metal After Turning	CAUSE OF REMOVAL	MAKER	Ry. Co's Initials on Wheel	WHEEL NO. DATE CAST	Service Metal	New or Sec. Hand	Net Charge
AXLE,						AXLE					
LOCATION	SIZE AND KIND OF WHEELS REMOVED and APPLIED				SIZE OF JOURNALS REMOVED and APPLIED				LABOR		
									TOTAL		

To Be Attached To Bill.

DATE....................191.... REPAIRED AT..INSPECTOR.........................

CAR NO. ....INITIAL OR NAME.. KIND..........................

M. C. B. ASSOCIATION---RECORD REPAIR CARD---(Wheels and Axles,

(NAME OF RAILROAD)

WHEELS AND AXLE REMOVED						WHEELS AND AXLE APPLIED					
MAKER	Ry. Co's Initials on Wheel	WHEEL NO. DATE CAST	Service Metal Before Turning	Service Metal After Turning	CAUSE OF REMOVAL	MAKER	Ry. Co's Initials on Wheel	WHEEL NO. DATE CAST	Service Metal	New or Sec. Hand	Net Charge
AXLE.						AXLE					
LOCATION	SIZE AND KIND OF WHEELS REMOVED and APPLIED				SIZE OF JOURNALS REMOVED and APPLIED				LABOR		
									TOTAL		

To be retained by parties making repairs

DATE....................191....   REPAIRED AT..INSPECTOR......................

CAR NO......................INITIAL OR NAME.. KIND.........................

RECOMMENDED CHANGES IN THE M. C. B. RULES, COVERING PASSENGER EQUIPMENT CARS IN INTERCHANGE.

RULE No. 10.

Paragraph A, change to read: "Axles broken under fair usage or having journals one-half (½) inch or more under the standard for car (except for three and three-quarters by seven (3¾ by 7) inches, which will be condemned at three and one-half (3½) inches, or having seamy journals, fillets, in back shoulder worn out, the length of journal increased one-half (½) inch over standard length, or collars broken off or worn to one-quarter (¼) inch or less under fair usage, may be renewed at the expense of the car owner. When axles are removed, on account of wheel defects, and the journals have increased in length more than three-eighth (⅜) inch, or the collars are worn to less than five-sixteenth (5/16) inch, the axles shall be considered as scrap. Size of journal should be stencilled on truck."

Explanation: These defects are all chargeable to car owner, and we believe they should be mentioned in the rules. They conform to freight car rules.

RULE No. 13.

Paragraph B, on first line, change figure 8 to figure 7; and, on third line, change figure 9 to figure 8.

Explanation: To correct typographical error.

RULE No. 15.

Paragraph B, line 3, change the word "spot" to read "surface."

Explanation: The term "surface" is proper, and also conforms with the wording of Rule No. 14, paragraph E.

Paragraph D, insert the following paragraph: "Wrought steel wheels may be substituted for steel-tired wheels."

Explanation: To provide for the substitution of wrought steel for steel-tired wheels on cars not assigned to regular line service, and to facilitate repairs.

LIST OF PRICES FOR MAINTENANCE OF PASSENGER EQUIPMENT CARS IN INTERCHANGE.

PAGE 143.

ITEM	Present Charge	Proposed Charge
Insert the following item: "Cushions, seat backs and isle strip of passenger cars, cleaning by air, per car		$0.45."
Change item "Bell or signal cord and couplings, renewed, per car	$0.75."	
to read "Conductor's valve or signal cord and couplings, renewed, per car		.75."
Change price "Burners, dual wick, renewed, each	.30	.35."
Change price "Burners, round wick, renewed, each	.50	.55."
Change item "Carpets, seats, draperies, etc., parlor and sleeping cars, removing and beating, per car	1.15."	
to read "Carpets, seats, draperies, etc., parlor and sleeping cars, removing and beating or cleaning by air, per car		1.15."
Change price "Chimneys, dual wick, renewed, each	.06	.07."
Eliminate the following, account of being included in new item: "Cleaning baggage cars, each	.60."	
Eliminate the following, account of being included in new item: "Cleaning common passenger and combination cars, each	.80."	
Eliminate the following, account of being included in new item: "Cleaning mail cars, each	1.75."	
Eliminate the following, account of being included in new item: "Cleaning parlor and sleeping cars, exclusive of bedding, per car	$2.50."	

ITEM	Present Charge	Proposed Charge
Eliminate the following, account of being included in new item: "Cleaning vestibules passenger and combination cars inside and outside, including vestibules and trucks, each	1.50."	
Insert the following item: "Cleaning exterior, ordinary, including trucks and interior and exterior of vestibules, by dry-wiping or washing (including necessary material:)		
"All classes of cars having single sash, per car		$0.30."
"All classes of cars having double sash, per car		.45."
Insert the following item: "Cleaning, windows only, exterior, single sash, per car		.15."
Insert the following item: "Cleaning, windows only, exterior, double sash, per car		.25."
Insert the following item: "Cleaning, interior ordinary, sweeping and dusting, baggage, express and postal storage cars, per car		.15."
Insert the following item: "Cleaning, interior, postal cars and mail apartment cars, including sweeping, cleaning and disinfecting wash basins and hoppers, per car......		.40."
Insert the following item: "Cleaning, interior, ordinary, including dry-wiping of sides, ends, fixtures, (furniture in dining cars,) from deck rail down; sponge with water disinfectant, window sills, heater box top and seat ends; clean inside of windows; clean and disinfect inside of saloons, complete, cleaning lamps; also, dust seat backs and cushions (including necessary material:)		
"Passenger and combined passenger and baggage cars, per car.......		.90

ITEM	Present Charge	Proposed Charge
"Dining or cafe cars, per car.......	'	1.80
Parlor or sleeping cars, per car....		...."
Insert the following item: "The following operations, which are included in the above items, are to be paid for at the prices shown, when necessary to perform separately:		
"Sweep and dust, clean and disinfect hoppers and urinals:		
"Passenger and combined passenger and baggage cars, all classes, per car		$0.20
"Dining or cafe cars, per car.....		.65
"Parlor or sleeping cars, per car..		.....
"Sweep, complete, including isle strip:		
"Passenger and combined passenger and baggage or baggage cars, per car		.07."
Change price "Coal, anthracite, (including labor) per ton	$6.00	7.00."

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ITEM	Present Charge	Proposed Charge
Change price "Hose, 1⅝ inch, straight port, steam, complete with fittings, applied.	5.00	4.50."
Change price "Hose, as above, 1½ inches	5.00	4.50."
Change *credit* price "Hose, as above, 1⅝ inch and 1½ inch, credit for fittings..	2.50	2.25."
Eliminate the following item, account of being covered by another item: "Loss of metal on steel or steel-tired wheels, per 1/16 inch	1.50."	
Eliminate the following item, account of being covered by another item: "Removing, turning and replacing same pair steel-tired wheels	5.75."	

ITEM	Present Charge	Proposed Charge
Eliminate the following item, account of being covered by another item: "Turning steel-tired wheels, per pair	1.75."	
Insert the following item: "Waste, resilient, per pound		.07."
Change item "Wheels, labor changing, first pair, per pair	4.00."	
to read "Wheels, labor changing, first pair, (except center pair.)		5.00."

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Insert the following item: "Wheels, labor changing center pair		$6.50."
Change item "Each additional pair in same truck, per pair	$1.00."	
to read "Wheels, labor changing each additional pair (except center pair in same truck)		3.00."
Eliminate item "Wheels, solid steel or steel-tired, new or re-tired	At Cost."	
and substitute the two following items:		
"Wheels, wrought steel, 36 inches, one, new	$26.00	$5.00."
"Wheels, steel-tired, new or re-tired.	At Cost."	
Eliminate item "Wheels, steel or steel-tired, loss of metal from, per 1/16 inch on radius of tread	$1.50."	
and substitute the two following items:		
"Wheels, wrought steel, 36 inches, value of service metal per 1/16 inch, (on radius of tread, in connection with full flange contour)		$0.875."
"Wheels, steel-tired, value of service metal per 1/16 inch, (on radius of tread, in connection with full flange contour)....		......"

The following note should be shown below prices for wheels:

"Note: A new wheel to permit a

ITEM	Present Charge	Proposed Charge
full charge must have not less than 1½ inches service metal; but, in no case, shall a charge or credit be made for service metal in excess of 1½ inches."		

Eliminate the following item, as it conflicts with, and is covered by, the proposed labor allowances for removing and replacing wheels and for turning wheels:

"Wheels, steel-tired, removing, turning and replacing, per pair.......	5.75."	
Change item "Wheels, steel or steel-tired, turning, per pair	1.75."	
to read "Wheels, wrought steel or steel-tired, turning, (not including R. & R.) per pair		1.25."
Insert the following item: "Brake shoes, flanged, renewed, each		$0.95."

	PRESENT Charge Lb.	PRESENT Credit Lb.	PROPOSED Charge Lb.	PROPOSED Crdeit Lb.
Change item:				
For Journals—				
10″ long and over....	25	15.		
to read:				
10″ long and over, but not 11″ long.......			25	15.
Insert the following item: 11″ long and over			37	23.

Change prices as follows:

	PRESENT New	PRESENT Second-hand	PRESENT Scrap	PROPOSED New	PROPOSED Second-hand	PROPOSED Scrap
Axle, 40,000 lbs........	$10.00	$ 5.00	$0 005 lb.	$10.00	$ 5.00	$1.95
Axle, 60,000 lbs........	13.00	5.75	.005 lb.	13.00	5 75	2.45
Axle, 80,000 lbs........	16.50	10.00	5.75	16.50	10.00	3.85

Explanations: The above changes and new items are recommended in accordance with Circular of Inquiry

No. 12, from the Committee on Prices for Labor and Material.

In conclusion your Committee desires to express its thanks to the members for the valuable suggestions received; also, its appreciation to the Club for the entertainment of the Committee during its stay in Pittsburgh while engaged in formulating its report.

Respectfully submitted,

C. E. BOYER,
Pennsylvania Railroad, Lines East of Pgh.

G. E. CARSON,
New York Central Railroad, East of Buffalo.

S. A. CROMWELL,
Baltimore & Ohio Railroad.

A. F. COULTER,
Union Railroad.

F. W. DICKINSON,
Bessemer & Lake Erie Railroad.

H. F. GREWE,
Wabash Pittsburgh Terminal.

W. J. KNOX,
B. R. & P. Railroad.

S. LYNN,
Pittsburgh & Lake Erie Railroad.

O. J. PARKS,
P. F. W. & C. Railway.

J. B. SWANN,
P. C. C. & St. L. Railway.

F. H. STARK,
Montour Railroad.

R. L. KLEINE, *Chairman,*
Pennsylvania Railroad, Lines East of Pgh.

DISCUSSION.

PRESIDENT: Gentlemen, the Report is now before you for discussion. We would like to hear from any one or all of you.

MR. L. H. TURNER: Mr. President and Gentlemen:—I do not suppose that the younger members of the Club realize that as they become old men, they are going to drift into the contented condition of the house dog, who lies by the fire place and dreams of the battles he fought in his younger days.

As I listened to Mr. Kleine reading his report tonight, I did some dreaming, and in my slumbers, I believed that if I did not do another good thing during the time I had the honor of presiding over this Club, I did do one meritorious act, when it became my privilege to name the first Committee on M. C. B. Rules of Interchange that the Club ever had. I do not know that all the members are aware that the Arbitration Committee, in developing and perfecting the Master Car Builders Rules, are influenced and governed to a great degree by the suggestions that emanate from various Railway Clubs and individuals over the country. And it may be information to some of you to know that more of the suggestions that are accepted, are made by this Club than all the others presented throughout the United States, indicating beyond question that the work is well done, and for that reason I want to move the acceptance of the Report of the Committee, accompanied by a hearty vote of thanks for the good work the Committee has done, not only in the year 1915, but in the years that have passed.

The motion was duly seconded and carried by unanimous vote.

MR. R. L. KLEINE: Mr. President, I believe there are certain features in the Report that should really bring forth some discussion. Take for instance the recommendation on the brake beam, making a uniform price for the M. C. B. standard No. 1 and No. 2 Beam. I believe the members ought to comment on that item. And also I feel that the Committee would be very much better satisfied if the members would take up the Report and discuss its several features. It is found that year after year your Committee makes suggestions, and some of the members can not understand how after we have gone through

the Rules so many times we can come to the Club again tonight and present to them a report twice the size of the one we presented last year. If we did our work right last year, why do we have a report double the size this year? That has been brought about, as I explained, by differences of opinion among the various railroads based upon the Rules as they exist, and of course these differences appear from year to year among the railroads. We would like to see the members take up these different questions and discuss them, or, if they have questions to ask as to how and why the Committee arrived at certain conclusions, we will be glad to answer the questions, if possible.

PRESIDENT: Is there any one in the audience who would like to take up any of the items Mr. Kleine has mentioned?

MR. G. E. GIES: The recommended change in the rules are so fair that I do not see that any one could have anything to say. But I would like to ask Mr. Kleine with reference to Rule 2 in regard to returning the empty cars in the same condition received from the other roads loaded. Is it still to be left to the judgment of the receiving road? That is what we are up against now. What better shape is this going to put us in, if this is adopted, than under the present mode or practice.

MR. KLEINE: At the present time the various railroads have been refusing cars in the very same condition in which they have delivered the particular car under load. Of course you must always leave to the receiving road the judgment as to what car they will accept. At present, the receiving road receives the car under load although the car may not be in what you may term A-1, or grain car condition. The car is moved to destination. When that same car comes back to the interchange point it requires no repairs excepting that the particular car is not fit for planished iron shipments, grain or package loading and it is refused because there is no load to take that car on to its home destination, and the delivering road which delivers that car empty is requested to place it in A-1 shape. Our recommendation is made to provide that the road delivering the car under load must accept it back in the same physical condition as they delivered it. There will no doubt be contention as to the condition of the car when they delivered it under load and when they receive it back empty. We can not govern

it more closely than to say that the road delivering the car under load must take it back in the same physical condition in which they delivered it, a thing which they will not do under the present rule.

MR. GIES: I do not understand what there is in this rule which compels them to take it. It does not say that they must take it, even though it is in good condition, if they have no load suitable to the car.

MR. KLEINE: I might read the rule as modified:

> "Empty cars offered in interchange must be accepted if in safe and serviceable condition, except that a car destined to a point outside of switching district, safe to carry load to destination, must be accepted, when empty, if moving on its home route, and if in the same general physical condition as it was when forwarded under load."

There is compulsion that they must take the car coming home empty if in the same physical condition. Of course there will still be contention as to whether that car is in the same physical condition. However if the car is safe to run, the main distinction is as to its commodity loading. The refusal of the car heretofore has been made on its fitness for commodity loading, and the change in the Rule is for the delivering company to receive back the car if in the same physical condition. If you can make the Rule any plainer we would like to receive and comply with the suggestion.

MR. G. C. WALTHER: Is it intended to make wrong wheel applied according to the proposed Rule 82 an owner's or delivering company's defect? If a car was offered in interchange with a lighter wheel than would be required by this proposed rule, would it be considered an owner's or delivering company's defect?

MR. KLEINE: This is on the subject of minimum weight of new wheel applied to the car. That would come under the ruling of wrong repairs to a car. It is not proposed to penalize the handling company for a wheel that has been applied by another road of less weight than that specified in the M. C. B. standards. But if such a wheel is applied by a road and the car comes home, then the car owner can take joint evidence and re-bill for a wheel of specified weight.

MR. C. E. BOYER: Before we pass on I would like to move that these changes in the rules and changes in prices recommended by the Committee be forwarded to the M. C. B. Arbitration Committee as the recommendations of The Railway Club of Pittsburgh, and also that copies of the prices be sent to the M. C. B. Committee on Prices for Labor and Material for their benefit.

The motion was duly seconded and agreed to.

ENTERTAINMENT.

PRESIDENT: If there is no further discussion on this subject, we will turn the meeting over to the Entertainment Committee who has prepared a program, and will endeavor to hold your attention for a while.

The Club was then favored with a most delightful entertainment, consisting of some marvelous sleight of hand work by Mr. George F. Huff, Jr., connected with the Pennsylvania Railroad Company, a brilliant monologue by Mr. E. H. Walker of New York and a charming musical programme by Mr. H. Murdoch and his pals, all members of the Club.

At the close of the entertainment the following motion was offered by Mr. F. H. Stark:

MR. F. H. STARK: If the man who makes two blades of grass grow where but one grew before is a benefactor of the human race, and we have good classic authority to that effect, what must be the measure of our obligation to one who made four billiard balls grow where but one grew before, and a hundred brilliant hued roses and miles uncounted of ribbon grow where none at all grew before? Such was the philanthropic accomplishment of our friend Huff, as you saw with your own eyes. And when this is but the precursor of other lines of entertainment equally delightful, it will readily be seen that adequate expression of our obligation is not possible. But as the best means now available, I would move a rising vote of thanks as an expression of our appreciation to those who have so graciously entertained us, and also to the Entertainment Committee who so admirably arranged the entertainment.

The motion was duly seconded and agreed to by unanimous rising vote.

Their being no further business.

ON MOTION, Adjourned.

J. B. Anderson
Secretary.

RAILWAY CLUB NOTES.

The following subjects were presented and discussed by the several Railway Clubs during the month of March as noted below:

New York Railroad Club, Harry D. Vought, Secretary, 95 Liberty Street, New York.

SUBJECT: Annual Electrical Night.

Central Railway Club, Harry D. Vought, Secretary, 95 Liberty Street, New York.

SUBJECT: Report of Standing Committee on Rules of Interchange.

St. Louis Railway Club, B. W. Frauenthal, Secretary, Union Station, St. Louis, Mo.

SUBJECT: Methods of Wage Payments, by F. H. Hamilton, Treasurer, St. Louis & S. F. R. R.

New England Railroad Club, Wm. E. Cade, Jr., Secretary, 683 Atlantic Avenue, Boston, Mass.

SUBJECT: Annual Meeting.

Western Railway Club, Jos. W. Taylor, Secretary, 1112 Karpen Building, Chicago, Ill.

SUBJECT: Results of the Locomotive Boiler Inspection Law, by Frank McManamy, Chief Inspector, I. C. C.

Canadian Railway Club, Jas. Powell, Secretary, Chief Draftsman G. T. R., Montreal, Canada.

SUBJECT: Railway Advertising, by Edward Hungerford.

Richmond Railroad Club, F. O. Robinson, Secretary, c/o C. & O. Railway, Richmond, Va.

SUBJECT: Railway and Agricultural Development, by F. H. LaBaume.

Southern and South Western Railway Club, A. J. Merrill, Secretary, Box 1205, Atlanta, Ga.

SUBJECT: Relation Between Mechanical, Purchasing and Stores Department, by R. E. Smith, C. Pierce and W. D. Stokes.

Copies of the above papers can be had upon application to the Secretary, at the address given, for a nominal price.

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OFFICIAL PROCEEDINGS
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FEDERAL REGULATION--A SUGGESTION

By Mr. J. G. Code, General Manager, Wabash Pittsburgh Terminal R. R.
Also Address by Dr. Wm. J. H. Boetcker,
President, National Inside Association

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OFFICIAL PROCEEDINGS

OF

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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING,
APRIL 23, 1915.

The regular monthly meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock P. M. by President, F. M. McNulty.

The following gentlemen registered:

MEMBERS.

Adams, C. F.
Adams, L.
Amsbary, D. H.
Anderson, J. B.
Babcock, F. H.
Barth, J. W.
Battinhouse, J.
Berghane, A. L.
Boyer, Chas. E.
Bruner, F. J.
Buckbee, W. A.
Byron, A. W.
Carroll, F. E.
Caton, S. W.
Chamberlain, W. A.
Clark, C. C.
Cline, W. A.
Code, J. G.
Cole, Jewett
Cooner, L. D.
Cooper, F. E.
Cooper, J. H.
Courtney, D. C.
Crawford, D. F.
Croft, E. P.
Dambach, C. O.
Duggan, E. J.
Dunlevy, J. H.
Dygert, H. B.
Farquhar, L. C.
Fogle, E.
Forsythe, G. B.
Fulton, A. M.
Gray, T. H.
Grewe, H. F.
Grusch, A. E.
Hammond, H. S
Harsch, A. M.
Haynes, J. E.
Heird, G. W.
Herrold, A. E.
Hill, J. F.
Hink, G. L.
Hobson, H. A.
Howe, D. M.
Howe, H.
Huchel, E. W.
Huchel, H. G.
Hudson, W. L.
Huff, George F. Jr.
Hyndman, F. T.
James, J. H.
Johnson, W. A.
Kelly, H. B.
Kinter, D. H.
Klein, R. A.
Knickerbocker, A. C.
Knight, E. H.
Lansbury, W. B.
Laughner, C. L.
Laylin, M. H.
Lehr, H. W.
Lidstone, F. J.
Lindner, W. C.
Lindstrom, C. A.
Long, R. M.
Lowe, W. D.
Lyle, D. O.
Maxfield, H. H.
Meigs, R. R.
Mensch, E. M.
Millar, C. W.
Miller, F. L.
Mitchell, A. G.
Murphy, W. J.
McCollum, G. C.

McKinstry, C. H.
McNaight, A. H.
McNulty, F. M.
Neff, J. P.
Painter, Joseph
Patterson, J. E.
Phillis, W. A.
Pie, Jos. J.
Postlehwaite, C. E.
Rabold, W. E.
Ream, A. H.
Reed, W. S.
Richardson, L.
Ridley, R. C.
Ritts, W. H.
Robbins, F. S.
Runser, K. W.
Ryan, Wm. F.
Schaaf, A. J.
Schaefer, F.
Schauer, A. J.
Shadle, C. S.
Shaw, H. D.
Sigafoos, G.
Sleeman, W. C.
Slutzker, Joseph
Smith, F. C.
Smoot, W. D.
Snyder, J. W.
Stucki, A.
Suhrie, N.
Sullivan, W. H.
Thomas, J. H.
Trappe, W. C.
Tucker, J. L.
Vowinkel, F. F.
Wagner, G. R.
Walter, W. A.
Warne, J. C.
Wyke, J. W.

VISITORS.

Boetcker, Wm. J. H.
Burkholder, H. F.
Calvin, A. W.
Code, Chas. J.
Code, Grant H.
Deem, G. M.
Early, G. G.
Edwards, W. A.
Fennell, R. T.
Foulk, E. A.
Goodwin, C. T.
Haynes, F. L.
Jackson, W. E.
Long, H. P.
Marcus, M.
Marquis, E. M.
Maxwell, F. R.
Paisley, R. M.
Rauterkus, J. A.
Ritscher, W. J.
Smith, A. C.
Stoner, E.
Stubblefield, D. R.
Sugden, J. E. Jr.
Walter, P. S.
Williams, A. G.
Williams, W. R.

THE PRESIDENT: Gentlemen, as we have the registration of those present by cards, the call of the roll will be dispensed with. The minutes of the March meeting are printed, in the mail, and should be in your hands by tomorrow morning. Mr. Secretary, are there any applications?

THE SECRETARY: Mr. President, we have the following applications for membership:

Ainsworth, J. H., Resident Inspector, N. Y. N. H. & H. R. R.,

903 House Building, Pittsburgh, Pa. Recommended by F. T. Hyndman.

Bloom, Chas. W., Assistant Chief Clerk, Fort Pitt Malleable Iron Company, 400 Russelwood Avenue, McKees Rocks, Pa. Recommended by A. M. Fulton.

Deem, G. M., Car Inspector, Penna. R. R., 6—8 Superior Street, Duquesne, Pa. Recommended by A. W. Bryon.

Edwards, Wm. A., Representative Colonial Steel Company, Keystone Building, Pittsburgh, Pa. Recommended by W. H. Sullivan.

Marcus, M. M., Chemist, Fort Pitt Malleable Iron Company, 255 Dunseith Street, Pittsburgh, Pa. Recommended by A. M. Fulton.

Root, R. R., Enginehouse Foreman, Penna. R. R., Maple Ave. and Fourth Street, Aspinwall, Pittsburgh, Pa. Recommended by T. M. Blakely.

Shaner, Earl L., Special Duty, Penna. R. R., 612 Industry St., Pittsburgh, Pa. Recommended by A. W. Byron.

Stevenson, Paul V., Res. Manager, Morse Chain Co., Westinghouse Building, Pittsburgh, Pa. Recommended by D. J. Redding.

THE PRESIDENT: As soon as the Executive Committee approves these applicants, they will become members of the Club. Are there any communications?

THE SECRETARY: We have a communication from Mr. J. H. McConnell who was the first president of The Railway Club of Pittsburgh, tendering his resignation as a member of the Club on account of being permanently located in California. When I received this communication, I thought it proper to refer it to the Executive Committee, and I therefore, sent it to Mr. L. H. Turner, the chairman, who offers the following:

Mr. L. H. Turner:

MR. PRESIDENT: Mr. J. H. McConnell, first President of this Club, and now a resident of Hollywood, California, has tendered his resignation.

Mr. McConnell has retired from railroad work, and we can presume that he is not so much interested in railroad affairs

as he was at the time he was actively engaged. During his railroad life, he built for himself a reputation that any of us might be proud of, and anything that was endorsed by "Mr. McConnell of the Union Pacific" in locomotive practice, usually came into general use throughout the country. We should feel that this Club cannot afford to lose Mr. McConnell as a member, and I wish to offer a resolution that he be elected an honorary member, and that our Secretary be requested to advise Mr. McConnell of his election, accompanied by the best wishes of the Club members for his happiness and prosperity during his declining years.

Resolution seconded and unanimously carried.

THE PRESIDENT: If there is no further business we are now up to the point where we will have the paper of the evening to be presented by our First Vice President, Mr. J. G. Code, who is also General Manager of the Wabash-Pittsburgh Terminal, on "Federal Regulation." It is my pleasure to introduce Mr. Code.

MR. J. G. CODE: Mr. President and Gentlemen of The Railway Club, I got in a little late from lunch the other day, and found that in my absence I had missed a call from the Secretary of the Club. My assistant told me that Mr. Anderson had called to inform me that he had secured the services of a *real* public speaker to address the Club this evening, a gentleman who could talk anywhere from five to two hours on any subject. I said, "Well, anybody going to talk that long, I think I will beat it before he gets started." He said, he didn't mean that; he meant five minutes to two hours. That gentleman is here, and his subject inclined me to change a little the title of my paper, which in the first place I had called "Federal Regulation." I want to modify that to read "Federal Regulation—A Suggestion," for fear that you may think that I expect to cover in one evening the entire subject of "Federal Regulation," and that you would be looking for "The only way out," before the subject was properly taken up. As a matter of fact, the only way out of this meeting, is by way of the cafe downstairs, where lunch will be served as usual. It is not ready yet.

FEDERAL REGULATION—A SUGGESTION.

By Mr. J. G. Code, General Manager, Wabash-Pittsburgh Terminal R. R.

The "Act to Regulate Commerce," taking effect early in the year 1887, and based upon the constitutional authority of Congress to regulate foreign and interstate commerce, inaugurated a system of federal regulation and control of business interests of the greatest magnitude in themselves and so closely interwoven with the business and social activities of all the people as to make the manner, extent and character of regulation of vital importance as related to national welfare. The Commission in its first annual report directed attention to this fact in the following words:

"The regulation of no other business would concern so many or such diversified interests or would affect in so many ways the result of enterprise, the prosperity of commercial and manufacturing ventures, the intellectual and social intercourse of the people, or the general comfort and convenience of the citizen in his every-day life. The railroads provide for the people facilities and convenience of a business and social nature which have become altogether indispensable, and the importance of so regulating these that the best results may be had, not by the general public alone, but by the owners of railroad property also, is quite beyond computation."

In the same report rendered after the act had been in operation about eight (8) months it was noted that *"one immediate effect was to cause inconvenience in many quarters"* which comment is probably equally applicable to the situation after twenty-eight (28) years of experience. This, however, is no indication that progress has not been made, nor good results obtained, as any restriction of individual or corporate action is practically certain to inconvenience some, even while generally beneficial.

The tremendous expansion of our resources in agriculture, mining, manufacturing, etc., during the latter half of the 19th century was made possible only by the rapid development of transportation facilities which, in many notable instances, proceeded materially in advance of actual needs, but in a manner to promote the opening of remote areas to population and all

the activities of civilization. That in the public interests federal regulation became necessary, was adopted, justified its adoption, is therefore properly adhered to, and will be continued and made more extensive by the will of the people, are facts of the situation which for purposes of this discussion are assumed to be settled. I am also assuming and firmly believe that Government ownership is not seriously considered by any great number of our people, and will not be until or unless the policy of regulation by Commission has absolutely failed.

There is an old Scotch fairy-tale of an enchanted flag given by a fay to a member of the Macleod clan. Thrice it would save him from the worst danger, but only thrice. After that it would be useless and must be burnt. As the story goes, Macleod waved the flag twice, once when his child heir was lost, again when the clan was hard pressed by enemies,—but he never waved the flag for the third time! Furled it lies in the treasure chamber of Dunvergan, while generations of Macleods bravely live and bravely die. No one of them will use the fairy's charm for the last time. The ballad, for the story was told me in verse, ends as follows:

"Macleod furled the fairy flag:
"Ye've served me twice in blessed stead—
But I shall in the churchyard lie
Ere I will wave ye thrice," he said!

"For if I thrice should wave the flag,
And thrice should get my heart's desire;
Next day might come a sorer need,
When it was ashes in the fire."

Macleod kept his word: he fought
For life on many a bloody plain,
He tossed in peril on the sea,
Nor waved the fairy flag again.

But still his kin in misty Skye
The fairy flag in keeping hold;
And sometime from the castle wall
May flash its spots and bars of gold.

But dire indeed shall be the need,
And every other hope be slain,
Ere a Macleod of the Isle
Shall wave the fairy flag again."

Government ownership is the last resort and its flag may well be kept in the treasure room of our castle, to be unfurled only when there is no other way to turn. Unlike the fairy banner we can use it not thrice but only once and must then abide the consequences.

Until very recently the repressive function of regulation has predominated. Naturally those features of the act aimed at the correction and prevention of abuses have been thoroughly worked to conclusion. There are now gratifying indications of an understanding that the function of repression of evil must be accompanied by cultivation of good through our instrumentalities of regulation if the people at large are to continue to enjoy the benefits of efficient transportation facilities. A broader conception of the duty devolving upon governmental authority will result in an extension of the powers of the Commission, and a very considerable increase in the amount of work to be performed by it.

The suggestion which I wish to advance relates solely to the situation as it exists and to the very probable extension of the authority of the Commission, and consequent increase in the amount of labor. Even though as it now stands a tremendous amount of business is handled by the Commission, which docketed in the year 1913, 16,764 cases. There were conducted 1,401 hearings, in the course of which approximately 140,000 pages of testimony were taken, which represents a good sized printed volume for every working day in the year.

There has been no material change in the organization other than an increase in membership from five to seven (5 to 7) and which it is now proposed to increase to nine (9). The quality of its membership has been well maintained, so that notwithstanding many acute differences of opinion it must be conceded that we have a board composed of men ranking very high in abiiity, capacity, sincerity, and devotion to the manifold tasks upon whch they are continuously engaged.

The reference before made to the number of cases doc-

keted, while indicating in a manner the volume of work directly handled or reviewed by the members of the Commission, does not cover the entire work performed under the authority of the Commission by its subordinate employes or bureaus, as of locomotive inspection, accounts, statistics and tariffs.

In working out the enforcement of the Boiler Inspection Law it has been found desirable to locate the inspectors of this division at various points throughout the country in such a manner as to insure frequent observation of the locomotive boilers and appliances. That this organization is effective most of us know. The men are "on the job" and the figures reported by the Chief Inspector in his 1914 annual showing 32% *decrease in the number of accidents, 36% decrease in deaths* and 32% *decrease in injuries* as compared with the previous year are at least primafacie evidence of efficiency.

The division of accounts now maintains representatives in seven (7) of our principal cities where they are in close touch with the accounting features of our principal railroad systems. These men too are "on the job" and the theory of uniform accounting is being evolved into fact.

For valuation purposes the country has been divided into Eastern, Central, Western, Southern and Pacific divisions, with headquarters in four (4) principal cities outside of Washington.

In the matter of hearings and investigations, however, the Commission has no fixed local representation. Its principal office is in Washington and there is provision for the conduct of hearings and investigations by one or more Commissioners in any part of the United States. This circuit riding feature was for a number of years frequently operative and it was quite the usual thing for members of the Commission to conduct hearings at various points in the territory immediately concerned in the matters at issue. But as the work increased it became exceedingly difficult for members of the Commission to absent themselves from headquarters at Washington until it is a rare occasion when a member of the Commission takes direct charge of any proceeding at an outside point. Such are almost invariably conducted by subordinate representatives of the Commission known as lawyer examiners, who report to the Commission for its review and action the evidence adduced, briefs filed, and recommendations.

On account of the large amount of work and the probability that it will continue to increase, further addition to the membership of the Commission has been proposed, and if it were wholly practicable to sub-divide and assign to certain members a particular share of the duties, the end might be attained in this manner, which is workable, however, only in some minor matters.

Are not the work and territory involved and interests affected now great enough to sub-divide in a more rational manner? I believe such to be the case, particularly as the development of successful regulation will require greater authority in the regulatory body coupled with a greater degree of accountability to the whole people.

My suggestion, which I hope may be considered in the line of progress, is:

> 1.—*Divide the country into six (6) districts,—Eastern, Central, Southern, Southwestern, Northwestern and Pacific.*
>
> 2.—*Assign to each district three (3) sub-commissioners with headquarters at convenient geographical locations in each district.*
>
> 3.—*Let all hearings and investigations be conducted by these boards of sub-commissioners singly when intraterritorial, and by joint representation when interterritorial.*
>
> 4.—*Forward to the Washington Commission for review and decision the record of hearing and investigation, lawyers' briefs and sub-commissioners' recommendations as is now done in cases conducted by examiners.*
>
> 5.—*Relieve the Washington Commission generally of the direct conduct of hearings and investigations, except in cases of such importance as in their judgment may make it desirable for one or more of their members to sit with the Local Commissioners.*

The personnel of all commissions is of vital importance. Salary and tenure of office should be such as to command experience, ability and honest devotion to the work. One member for each of the sub-commissions may well be assigned from the Commission's corps of examiners, whose experience qualifies them to produce results. Give them a chance to settle down and

get a thorough acquaintance with the transportation and business needs of a particular territory and they can do better work and more of it. One member on a sub-commission should certainly have general experience in the conduct of railway operations. A third member should be a representative of general business or shipping interests.

The benefits of such an organization are readily manifest. Among them may be cited:

1.—*Washington Commission can give more concentrated and thorough attention to the larger problems and policies of regulation and control.*

2.—*Washington Commission can serve more efficiently in advisory capacity to Congress and the President. The Chairman of the Commission should be ex officio a member of the Pesident's official family and on the same footing as a cabinet officer. The President and the Congress should have the benefit of the expert knowledge possessed by the Commission in considering proposed legislation.*

3.—*Local Commissions should foster a better understanding and closer relationship and co-operation among all interests including what is extremely important, State and other local regulatory commissions.*

4.—*Business can be handled with greater expedition and we will have less standing still and marking time while waiting for action.*

5.—*Much loss of time and long distance traveling may be avoided.*

6.—*The Commission will be "on the job."*

THE PRESIDENT: Gentlemen, the subject is now open for discussion. We would like to hear from you. This is a live question. I see Mr. D. F. Crawford, General Superintendent Motive Power, Pennsylvania Lines West, is present. We would like to hear from him.

MR. D. F. CRAWFORD: Mr. President and Gentlemen, all that I can say is a hearty commendation of Mr. Code's paper and of the sugestions contained therein. I sincerely hope that it is not Utopian. I have spent fully half of the last ten years

of my life before the Commissions and committees of the Legislatures of the several states through which the Pennsylvania Lines operate, and committees of the Federal Congress. Every one of Mr. Code's suggestions rings true. They are all needed for a better understanding of the situation as we are confronting it. I believe that such a commission with such an organization will remove almost entirely, if not entirely, what I think we can well term petty legislation. The gentlemen who sit as the legislature of a certain state, say that the headlights shall have a reflector twenty-three inches in diameter, without any further specifications; those who sit in another state say that the headlight shall have 300 watts at the arc; the gentlemen who sit in another state say that you shall see an object the size of a man eleven hundred feet away from the locomotive, without stating whether that object is to be dressed in white, black, brown or blue clothes. Then there is another state which tells us that they want a headlight having 1500 candle power, and no other specifications, and still another state says they would like to see whistle posts and other land marks 350 feet in advance of the locomotive. I believe that a commission organized and developed under the plan proposed by Mr. Code would wipe out the inconsistencies I have mentioned and which make it impossible for us to buy a headlight, because we really don't know what any of them want. I believe it also would have prevented the passage, by the Federal Congress at Washington, at four o'clock in the morning, of a law extending the authority of the Chief of the Division of Locomotive Boiler Inspection over the entire locomotive and all of its parts and appurtenances thereto, including the tender. If the gentlemen who advocated that law know what it means, they know more than any railroad man in the United States, from top to bottom. They haven't the slightest idea of what that law includes, or what it covers. I do not think that there would be any fifty car train laws in one state, sixty cars in another and half a mile long in another. One of the questions asked me was, Did that half mile include the engine and cabin car? I don't know. One of the other questions that has been asked me, in fact, today, was whether there was any particular kind of sixty cars. We have some cars that will hold seventy tons apiece and we have others that will hold thirty tons the law does not say whether our trains

shall be made up of sixty of the thirty ton cars, or sixty of the seventy ton cars.

There is only one point in Mr. Code's paper that I don't quite agree with, and that is the very optimistic statement made by the chief of the Boiler Inspection Bureau as to what his Inspection Bureau did. I hope he did it and I hope he will continue to do it, but there is an old Spanish proverb, which I won't give you in Spanish, because I don't know the language, which states, "What has not happened for two years, may happen in two minutes." It is quite correct. I have seen some automobiles skid into telegraph poles, and only the day before yesterday there was a perfectly harmless telephone pole standing by itself, and an automobile standing all by itself, and the pole quietly broke off and fell on the automobile.

The Public Service Commission of the State of New York, which has had five years experience in conducting a locomotive boiler inspection bureau, state in their report for 1913, that they doubt very much the wisdom of continuing the locomotive boiler inspection department, as the officers of the mechanical departments of the railways have so adequately performed their work that they do not see why it is necessary. And then they go on and show a tabulated statement as to the number of accidents before and after—really not before, but the first year, which can be assumed as being before the boiler inspection bureau was established, because surely any rules they put into force had not had time to make a radical change in the conditions that had been in effect, and during five years from 1909 accidents were reported as follows: 1909, 12 accidents; 1910, 11 accidents; 1911, 36 accidents; 1912, 35 accidents and 1913, 27 accidents. Now I do not mean for a minute to decry or to criticize the boiler inspection department of the Federal Commission. I am well acquainted with a number of the gentlemen connected therewith, and their work has been of the most meritorious character, but the question in my mind is as to whether the public of the United States of America have gotten back the $225,000 paid those gentlemen for performing their work, which they earned, and whether they have gotten back the $6,600,000 paid by the railroads for improving a theoretical and not a practical condition. Do not misunderstand me. There has been improvement. The question is whether the improvement or all of it,

has been worth while. Another question is whether we cannot accomplish the same improvement with very much less documentary evidence. The Public Service Commission of New York remarked in the 1913 report, "The mass of correspondence reaching this office and the number of reports reaching the office is so great that we could not inspect the boilers." I believe thoroughly and fully with every one of Mr. Code's suggestions. I believe that his suggestion will wipe out one point that in my remarks may have savored of criticism, but which is not meant for criticism of the very efficient work done by these people. Their rules are laid down for them, and I will testify that they are doing their work with extreme efficiency.

THE PRESIDENT: Mr. A. G. Mitchell, Superintendent of the P. R. R. and Past President of the Club. We would like to hear from you.

MR. A. G. MITCHELL: Mr. President and Gentlemen, I do not feel that I can say much on the subject, except that I heartily corroborate what has been said by the last speaker and by Mr. Code, who preceeded him. In the question of regulation I have always felt that regulation should be by past masters of the business and not by students, and, if it is possible, the ideal condition of this country would be for the Interstate Commerce Commission to be co-ordinated in some way with the state commissions, so that there could be uniformity through the various states. I understand that the Chief Justice, has said that it is possible for Congress to pass laws which will bring about such a condition and I would be very glad indeed, to see the Interstate Commerce Commission, given supervision over state commissions, so that this desired result can be brought about.

THE PRESIDENT: We would like to hear from Mr. A. Stucki.

MR. A. STUCKI: Mr. President, we never before had a paper as concise and full of suggestions as this one. Mr. Code must have given this matter a great deal of thought and in trying to make the Interstate Commerce Commission more effective and more businesslike, he undoubtedly hopes thereby to do away with the state control and state legislation.

This latter, so called regulation, is especially objectionable and against economic operation of a road, because most of it is

not practical and not understood, and besides that each state has something else, just as Mr. Crawford and Mr. Mitchell have illustrated.

With the suggestions made by Mr. Code, I feel that there is a possibility of obtaining the most effective system of Railroad operation, namely, private ownership controlled by the government in a fair and speedy way.

That this system has given the best results in every case compared with Government Ownership is not an opinion, but a fact, and can be established by comparing the railroads in the different countries and again by comparing the two systems in one and the same country.

This will hold good in every detail. Look at it from the viewpoint of the passenger as to comfort or as to fare; look at it as a shipper would, and every time the privately owned road has the better of the argument.

The same holds true from a financial, construction and investment standpoint, and I feel confident that the paper tonight is leading in the right direction towards fairer and speedier government control and abolishment of state control.

THE PRESIDENT: Are there any others in the room that care to enter into the discussion? (none responded)

THE PRESIDENT: We have with us tonight Dr. Wm. J. H. Boetcker, President of The National Inside Association and Commissioner of The Pittsburgh Inside Association. We would like to hear from him. Possibly he can give us some information on the subject of Federal Regulation.

THE ONLY WAY OUT.

Dr. Wm. J. H. Boetcker.

"Mr. President, members and friends of The Railway Club it is unnecessary to assure you that I consider it a privilege indeed to appear before this body of men, representing and being connected with one of the most important branches of American commerce, that is, the railroad.

It is significant of our times to see the spirit of "Getting Together" everywhere displayed. There was a time when competitors in business did not care to meet, they were afraid they

might like each other, and if they did, they could not hate each other as much as they would like to.

Men are getting bigger and broader; they begin to feel nationally, as President Wilson recently said: "The people of America are getting tired of fighting about little and insignificant things."

There is a story told that in the middle ages, two ministers had a quarrel about the meaning of the original text, all on account of a period. Two denominations fought each other for centuries, one recognizing, the other ignoring the period and its possible meaning. Finally a chemist discovered it was a fly speck, it was not a period. Yet a few theological pin heads have been fighting about the fly specks for 200 years. The American people are getting tired of fighting about fly specks.

A new era is coming, an era of construction where we will no longer tear down in the name of "Reform"; where the motto will be "Up with everything that is down" and not down with everything that is up.

What will be the platform? Which will be the slogan that will usher in this new era? It is a phrase in which we all believe, that is, "A Square Deal." Every man is entitled to and shall get a Square Deal in the new era, but every man must bear in mind that there are four sides to a Square, three besides his own, and then the "Inside."

To talk to you about the "Inside of Modern Problems" and also about "The Only Way Out" of the present difficulties will be the topic of my address tonight.

Problems Before Us.

There was never a time when a nation was confronted with so many perplexing problems as we of today. We deal with political, economic and social problems, the trusts, child labor, woman labor, prison reform, church problems, woman's rights, marriage and divorce problems, etc. Let us bear in mind that a disease cannot be cured unless we find its cause and that no problem can be solved unless we deal with causes and not with cases.

Permit me to cite two court decisions which illustrate my point:

The one is known to every lawyer as the famous Squib

case; the defendant A. threw a lighted squib or fire cracker into a crowd of people, one after another of whom, in self protection, threw it from him until it exploded in the face of the fifth party and blinded him. The court decided that the first man who started the wrongful act as responsible for the damage, for his action was the proximate cause.

Another decision known as the Brick case, which may be but a joke, shows the folly of some modern reformers:

A. and B. had an argument which ended in a fist fight. A., fearing that he might come out second best, picked up a brick and threw it at B. B. saw the brick coming and stooped, the brick passed by and went into a show window. The store keeper had both men arrested and it was up to the judge to decide who should pay for the window.

The judge knew that a man could not be convicted of a crime unless intent could be shown. He reasoned that A. who threw the brick had no intention of breaking the window, but B. who stooped had done so intentionally, for as a prudent man he should have known that by stooping the brick might pass and cause some damage not intended. So the judge decided that B. who stooped should pay for the window. He blamed the nearest man.

Reformers.

We are blessed, if not cursed, with too many so-called reformers who claim that they can solve all problems, and who yet make the very mistake of this judge in the Brick Case. I challenge any and all modern reformers that ere they compound remedies for an evil, or solutions for any of the problems, they study the same carefully, get the facts, then apply the rule of proximate cause, and I rest assured that most if not all, of them will change their plan today—for when they find and deal with causes and not with cases, they will no longer place the blame upon the nearest man who may be but an innocent bystander.

I am convinced that the majority of our modern reformers will not only not solve the problems, but make the disease worse, for they only deal with the surface, with the outside.

I suggest that we start a campaign of education in order to first of all reform our reformers. Never before did the peo-

ple of America have so many reasons for praying; "God protect us against our friends and we will protect ourselves against our enemies."

We do not permit a physician to practice medicine unless we are reasonably sure that he knows how to make a correct diagnosis of a disease.

Our country is inflicted with a great many so-called reformers who are incapable of making a correct diagnosis of the real ailments of the day. They are guilty of the same mistake as the physician who has made a wrong diagnosis of a disease and then prescribes external remedies instead of internal treatment.

A physician is indeed either an imbecile or a faker who claims he can cure all skin diseases with salve, for the real disease is mostly in the blood beneath the skin and needs treatment from within.

Many reformers and their schemes remind me of certain patent medicines that are not intended to cure diseases, but only to kill the pains and create a demand for more medicine.

Some of them recall the story of a farmer who had an old time clock in his house. Since he was a boy he could remember its monotonous tick, tack. One day the clock stood still, and he went to the city, called upon a watch maker and asked him whether he could fix it. The latter replied that he would come out to the home of the farmer the next day and try. The farmer said that was not necessary, pulled a four foot pendulum from beneath his coat, placed it on the counter and requested the watch maker to fix the pendulum. The latter remonstrated saying that he had to see the clock, but the farmer insisted that the clock was all right, that the pendulum was at fault.

The mistake of this farmer is, in my opinion, the mistake of most reformers. They see that something is wrong with the world, that something is wrong with society. They notice the pendulum stand still, but they want to fix the clock by making the pendulum go from without, and forget that the trouble is within the clock and not without.

Industrial Pyramid.

I stand before you as the son of one of the poorest work-

ingmen of the city I came from. I was brought up among the socialists of Germany, and it was but natural that I inhaled so much of the socialistic atmosphere that I had an inborne prejudice if not hatred against the employers or as the socialists call them the capitalistic class.

The illustration which gave me a better and the only true view of the Industrial problem came to me when I visited Egypt a number of years ago.

One morning a company of nine travelers started to visit the pyramids, those relics of Egyptian civilization. We all took pictures of the same thing at the same time. When we returned to America we developed our plates and comparing notes, found that all nine had different pictures of the same thing. Four of the men had placed their cameras so close that their pictures showed but one side of the pyramid, yet each of the four claimed that his picture represented the pyramid. None ever thought of stating that it was but one side, and that there were three other sides which the picture did not show. Four of the genlemen had placed their cameras at a longer range and their pictures showed two sides of the pyramid. I myself had been at the top of the pyramid and had taken my picture looking down from where I saw four sides.

While I stood there and looked at these four sides the thought came to me that there must be another side of the pyramid. I went down and looked at the Inside, and when I saw how massive the pyramid had been constructed from within, I realized that it was in fact the inside which upholds the outside.

When confronted with one of the conflicting problems and apparently contradictory views of our time, I can but think of this pyramid with its four outsides and one inside. I see the employers and business men looking at the financial side. I see the workingmen on labor's side. I see attorneys and legislators on the legal side, and consumers on the fourth side.

Gentlemen, while we are talking about, asking for, and ever ready to promise a square deal, let us not forget that there are four sides to a square, three sides besides our own, and then don't forget the inside, or moral side which upholds the outside.

You cannot cure the inside from the outside, but you can cure the outside from the inside.

On the financial side we judge a man by what he has. On the legal side by what he does. On the employers' side by what he knows, and on the consumer's side by what he wants.

Legal Side.

On the legal side we find men who think that the enactment of new laws will solve all or most problems, and you will remember as well, that for years the slogan was, that the only way to solve the industrial problems was the enforcement of laws.

Let me tell you that, while legislation is necessary, yet it never has solved and never will solve fundamental problems, for all the written laws of the statute books cannot reach the inside of man.

We can pass laws and compel a man to support his wife, and children, but we cannot compel him to be decent and kind to them. We may fix a minimum rate of wages, but we cannot by law force a man to do his duty and give an honest day's work if he wants to shirk and soldier on the job.

We can by law reduce the hours of labor—but on the inside we find it is not what the people do when they work, but what they do when they DON'T WORK, that causes most misery.

Millions of men and women are engaged in a fight for their legal rights, but on the inside we find that they forget all about their duties.

We hear the cry of millions for laws to deliver them from wage slavery, but on the inside we find that men are not so much slaves of wages as they are slaves of passions and appetites.

We may at best pass laws and restrain men from doing positive wrong, but we cannot by any law human or divine, compel a man to be positively good.

To those who fancy they can reconstruct the whole world, and solve all problems by passing all kinds of laws, let me hold up before you in one sentence, your fundamental mistake:

> "Never do for men, what they should and could do for themselves. The more you do for them, the less you can do with them."

Labor's Side.

On labor's side we find the employees confronted with problems of their own, trying their best to solve them. Unfortunately a great many selfish, designing demagogues have taken advantage of the situation, have capitalized the woes of the workmen, have misled and misinformed them by making all kinds of promises, offering all kinds of schemes with which they promise to eliminate all evils.

There are laboring men who honestly believe that manual labor alone produces all wealth, and it is an almost impossible task to convince them that whenever they enforce an artificial increase in wages, they themselves will ultimately have to pay the bill.

If labor produces all wealth, who will ultimately pay the freight if they keep on with their present policy to produce less and get more?

Without going into details on any phase of the labor problem, let me call your attention to the Inside, i. e. we will never solve the problem of making a first class living unless we solve the problem of giving the world a first class life. If you want to earn more, learn more. If you want to get more out of the world, you must put more in. The world does not owe any man a living, but every man owes the world a life, and no man has a right to demand first class wages if he has nothing to offer but a stomach and a wish bone.

On the inside of the labor problem, I find not so much a problem of the unemployed as a problem of the unemployable.

On the inside I discovered different causes and the real needs of today. I met men who were fighting for higher wages, claiming that they wanted them to take care of their wives and children. I went to the homes of some of these men, and found their families praying, "Oh God give us a decent, kind and sober husband and father."

On the outside I see people crying about empty stomachs and empty pocketbooks, but on the Inside, I often find empty brains and empty hearts.

Consumer's Side.

There are millions on the consumer's side joining in the world-wide cry about the high cost of living.

Let me tell you men of America, that you will never solve the problem of the high cost of living unless you go to the INSIDE and solve the Problem of RIGHT LIVING.

But a short time ago the government reported that the total value of the 1912 crops had reached the tremendous sum of Nine Billion Dollars, or a Hundred Dollars per capita. Yet we cannot silence this public clamor about the High Cost of Living.

Men in public life have used this issue for their own aggrandizement and vote-getting. They have looked at the surface and either did not care, or did not want to pierce the inside of the problem.

What do I mean? I mean that any thinking man who seeks the cause of this problem, will soon find that the nation is not so much confronted with the High Cost of Living as with the COST OF HIGH LIVING and WRONG LIVING.

I have before me statistics showing that the money which we waste in this country in one year through wrong living amounts to the appalling sum of $30,853,000,000, or $340 per capita. I cannot present here in detail the different items that make up this amount, owing to lack of time.

But in a specially prepared lecture "WHY MEN FAIL" (for men only), I present the scientific date, and you will agree with me that it is the cost of wrong living that confronts our country today. The amount of time, human vitality, energy and money we waste through WRONG LIVING would build and pay for 12,341,000 homes at $2,500 a piece in one year.

The thirty billion dollars I refer to include the entire liquor bill and its appalling expense, time, energy and money spent for superficial amusements, shallow pasttimes, cigarettes, stimulants, dopes, fake medicines, gambling, immorality, diseases and countless vices, and yet in spite of the fact that the waste in this country, on account of wrong living amounts to three and one-half times the amount of the crops, we still have men apparently honest, who can see nothing but an economic problem that confronts us today.

Let me emphasize just two items of the cost of Wrong Living: This country spends annually, between the hours of six and ten at night, in time and money, Six Billion Dollars for shows and entertainments. Now I do not say it is wrong

for any man to go to the show, but there is something wrong with the Inside of a man or woman who can do nothing else in their spare time than go to the shows.

I have before my vision a cartoon called "The Bread Line." On one side I see hundreds of tramps standing in line waiting for a loaf of bread, empty stomachs and empty pocketbooks. On the other side I see thousands of men and women standing in front of a Burlesque or other cheap shows trying to get in. What are they if not empty brains and empty hearts.

It reminds me of my time as a student. Many a day I bought ten cents worth of hard candy. I took two pieces in the morning, four at noon and five or six pieces at night. It took my hungry feeling away, but it did not satisfy my hunger.

Believe me men of America, that the six billion dollars now spent as indicated, may at its best take the hungry feeling away, but will not satsify the craving of the human mind and heart for something money cannot buy.

Another item worth while mentioning. Do you know that the American women spend Ninety Million Dollars a year for cosmetics, powders and face creams? Just think of it. If I give you a check for $1.00 and you raise it to $1.05, I could have you arrested and sent to jail as a crook, and the women of America spend Ninety Million Dollars for artificial means to increase their face value.

Capital's *Side*.

The Capital's side is probably the one which is most misunderstood and misrepresented. The people at large begin to look upon all employers as a class of heartless capitalists who, in order to maintain their own standing, try to keep the workingmen down in hopeless poverty.

What a fool that employer is who does not know that the highest priced man is the cheapest and the cheapest man the most expensive.

Very few people know that less than five per cent of the American employers work with their own capital and that 95 per cent borrow money in order to carry on their respective establishments

What does this 95 per cent of employers furnish? Brains, executive managing and business ability. They furnish fore-

thought and fore-sight and many other superior qualifications which indeed make them the back bone of our country.

Little do the American people at large understand the years of hard work, the many sleepless nights, the worry and anxiety the average employer had to go through before he became a captain of industry.

The people seem to forget that at least 90 per cent of the employers of today started as employees, that is, that the employees of yesterday are the employers of today and that the employees of today will be the employers of tomorrow.

If the employer's side is so much misunderstood, it is to a great extent, due to their inexcusable indifference and passive resistance. Business men have forgotten that public sentiment is the most powerful factor in the life of a City, State or Nation. If right minded men don't form it, wrong minded men will, and they do, and have done it long enough.

A few years ago the German Emperor remarked: "If I don't present my side, my enemy will, and he will misrepresent it."

If the business men of America do not get busy and start on a nation wide constructive campaign to present their side, their enemies will, and they have done it but too long.

Who is the employer? 95 per cent of the American employers are not capitalists. Who then are they? They are the men on the Inside, who furnish brains and executive ability; men who stand between labor and capital and who handle capital with one hand and labor with the other. Men who create opportunities for labor to be employed and for capital to be invested. That is, "The Man on the Inside."

It is here where the employer should find and discharge his duty. It is here that the business man should prove to be the bigger and greater man. It is here that you should display the spirit of the Nazarene and say "Forgive them, they know not what they do."

Employers should therefore leave nothing untried to pave the way for the development of their employees. Too long we have been making dollars and forgotten to make better men. If the employers are not willing to show the workmen the RIGHT WAY and how to improve their condition, then they are to blame if others show them the WRONG WAY.

Employers must decide upon a definite policy for constructive work.

The employer who succeeds in whipping his men into submission will find that he has worse enemies than he had before, even though he thinks he won.

Employers in the past have been willing to spend fortunes to fight employees when they were wrong, and some of them refused to give a dollar to help them when they are right.

As manufacturers you do not care to have employees who carry with them constantly the insane suspicion that you were oppressing them or intend or try to oppress them. It is the experience of men of affairs all over the world that the Gospel of failure, envy and despair will paralyze the ambition and often brilliant abilities of men, until they are finally good for nothing, neither to themselves or anybody else.

The rank and file of workmen want to do what is right, but they have been misled.

One more word to you who stand on the financial side:

I know that I voice millions of honest workmen in America when I say "HELP US IF WE ARE RIGHT, SHOW US IF WE ARE WRONG."

Signs of the Time.

If the majority of the bank depositors in this city or State, conspired to overdraw their bank accounts, it would mean financial disaster, a panic without parallel in history.

Go through the streets of our cities any day or evening, look at our men and women, especially our boys and girls, study their faces and note their empty brains and empty hearts. Observe how so many of them spend their evenings with superficial amusements, without any resources of their own, instead of growing and developing from within, they just kill the time by amusements from without.

What are they if not overdrawn bank accounts, i. e. men and women who draw out of the world more than they put into it? Boys and girls who want to reap before they have sown.

Look at the counterfeit girls and women as you pass them, dressed to kill, like Indians on the war path. What for? To arouse the passions of men, to kindle the fires which lure thou-

sands of girls to ruin if not to shame and disgrace, sapping the life of our youth until they disappear in the whirlpool of society, high or low.

If we do not check this now, you will find that these very elements will tax our country in a few years with an overhead expense no nation can bear. What will be the outcome if we do not check the tendency to do less and get more?

Developing Human Resources.

If I could take you business men to Arizona or Texas and show you 30,000 acres of non-productive land, and convince you that an investment of one dollar per acre for ten years would develop the land and make it produce at least $10 per acre profit, you would not hesitate a moment to invest millions of dollars and wait ten years for returns, and think that it was a good business proposition.

If I came to your shop or factory and demonstrated that a certain improvement in your machinery would increase your output, you would not hesitate to borrow money if necessary to buy the new machinery.

But citizens, you who are ever ready to spend money for the development of natural resources and improvement of machinery, don't you think that it also pays to invest money for the devolopment of human resources? We have in our country at least 20 million children, boys and girls who will be wage earners and wage spenders in ten to fifteen years. What are we doing to develop these vast human resources?

You employers know that outside of the Executive Heads you need two forces to carry on your industries: First, men and secondly capital, I fear we have been too busy making money to produce capital and we have forgotten to at the same time make for better men, and you know that the one universal cry from one end of this country to the other is the cry for good men. You can get men expensive at three bunches for a nickle, but they want $3.00 per day.

You can find plenty of men who come to you with nothing but a stomach and a wish bone, demanding a first class living. They do not know that a stomach is not an asset but a liability.

To be sure great progress has been made during the last

few years towards industrial education and vocational training. Due credit should be given to those who have made our great trade schools and similar institutions possible; yet I am convinced that most of what we call school education is no education at all, only information from without and not real education from wtihin, and that our entire educational system will prove to be a disastrous mistake, if not a farce, if we forget to teach our children what to do with education and how to use their knowledge, i. e. to primarily give the world a better and more useful life, and not merely teach for the purpose of making a better living.

You may teach a man a trade and make him a first class mechanic, yet he may be a detriment to your business if his heart is not right. The most skilled mechanics may become dangerous to your interests so long as they look upon you as their suppressors and believe me, there are millions of men who honestly, though mistakenly believe, that the employers were identical with suppressors of labor, men who try to reap where they have not sown.

In other words, we must not only give our men information from within, but also real and true education from within.

To do this effectively, we must teach the fear of God, the beginning of wisdom. We must take care of the Inside, the moral side. We must teach our boys that there is more lasting happiness in being an honest workman in overalls, than in being a cheap though well dressed clerk behind the counter, or a degenerate or moral leper in a full dress suit.

We must teach our girls that there is greater honor in being a wife, a mother and a home maker in a one story cottage, than to be called a wife while in fact only a private mistress in a golden castle, or a walking advertisement for the financial standing of a husband.

We must teach our girls the true ideals of girlhood and womanhood, and plead with them not to imitate but rather to despise a certain type of women, often mistakenly called fashionable, whose very face ill concealed beneath its war paint, tells the story of the price paid for a life of luxury, the dresses and jewels but a receipt for services rendered.

Gentlemen, in coming to the conclusion, let me make a final appeal.

In Europe we find millions of men who are out on the battle field ready to fight and die for their country.

What this country now needs is men who will stay at home to work and live for their country.

When a few months ago, the American people thought that our flag was insulted, we were ready to raise an army of a million men to go to Mexico to fight and die for their country, and when we heard that a few American women had been outraged by Mexican men, we were ready to send two million men to Mexico to avenge for the honor of a few American women.

Every father present here tonight would be willing to fight and die for his own daughter.

Every brother would fight and die for his own sister.

Every son would fight and die for his own mother.

Every husband, worthy of the name, would fight and die for his own wife.

Well then, men let us stand not only for a Square Deal in business, but also for a Square Deal between woman and man.

Let us be what God wanted men to be, the natural protectors of women, pledged to look upon every woman as someones sister, daughter, wife or mother.

"The Only Way Out," that is, the only way to solve any or all problems before the American people, we must bear in mind that what this country really needs are things which money cannot buy. We must understand that all problems are on the outside but the solution must come from the INSIDE. We can never reach the inside from the outside but always the outside from the inside.

Let us all put our shoulders to the wheel and help usher in a new era. The era of a "Square Deal," where men can make a first class living if they are willing and able to give the world a first class life.

An era where a man is judged by what he is and not by what he has.

An era where the citizens solve their problems of Political Economy by Domestic Economy.

An era where the people govern themselves collectively, because they have learned to govern themselvs individually.

An era where there exists Universal Brotherhood, because they have recognized Universal Fatherhood.

You may have money to build the most beautiful house, but it is only with a genuine woman that you can make it a real home, and what the homes need most are things which money cannot purchase, and money cannot buy. There may be some who are hungry for bread, but we are all hungry for love and affection. You may see a Geranium dying and withering, you may think that a little richer soil will save it, no it may kill it, what the Geranium needs is more sunshine, and what our homes need is not necessarily more money, but more sunshine.

THE PRESIDENT: Does any one wish to ask the doctor any questions? If not, we will ask Mr. Code to close.

MR. CODE: Mr. President, I have really nothing further to say. I laid my cards down in the paper which I read. I appreciate the fact that Mr. Crawford was here tonight and able to comment so correctly on the numerous local regulations with which we have to contend. My allusion to the Federal Boiler Inspection was simply intended to indicate that the Inspectors are not traveling out of Washington to all parts of the country. Those men are on the job; that is the point I wish to make.

MR. A. STUCKI: Mr. President, I am sure that I speak for every member in the room when I say that we are greatly indebted to Mr. Code for his exceedingly valuable paper and to the other gentlemen for helping to discuss it, also to Dr. Boetcker for valuable suggestions, hence, I move that the club extend a rising vote of thanks to them.

The motion was unanimously agreed to.

ON MOTION, adjourned.

J.B. Anderson
Secretary

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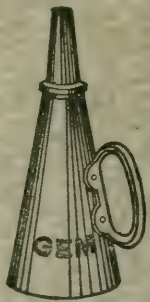
Vol. XIV. MAY 28, 1915 No. 7.

NOTES ON ELECTRIC POWER DEVELOPMENT

By E. M. Herr, President Westinghouse Electric & Manufacturing Co.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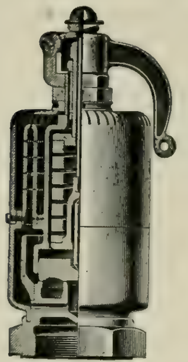

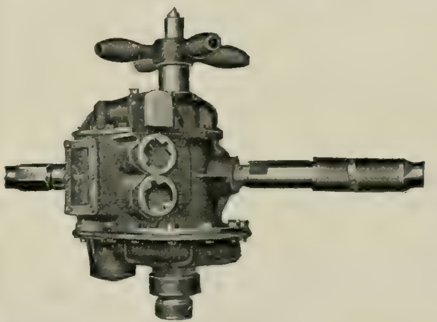

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OFFICIAL PROCEEDINGS

OF

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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING, MAY 28, 1915.

The meeting was called to order at the Monongahela House on Friday, May 28, 1915, at 8 o'clock, P. M. by President F. M. McNulty.

The following gentlemen registered:

MEMBERS.

Allison, John
Amend, George F.
Anderson, A. E.
Anderson, J. B.
Antes, E. L.
Austin, F. S.
Babcock, F. H.
Barth, J. W.
Battinhouse, J.
Bloom, C. W.
Boehm, L. M.
Bond, W. W.
Boyer, Chas. E.
Bradley, W. C.
Brandt, E. K.
Brantlinger, J. H.
Brewer, W. A.
Brosemann, W.
Buffington, W. P.
Burket, C. W.
Butler, W. J.
Caine, C. D.
Calvin, A. W.
Carrol, F. E.
Cartee, W. R.
Cassiday, C. R.
Cato, J. R.
Chapman, B. D.
Chester, C. J.
Cline, W. A.
Code, J. G.
Conner, W. P.
Cooper, F. E.
Cooper, Wm. M.
Cornelius, R. D.
Courtney, D. C.
Cotton, A. C.
Croft, E. P.
Cunningham, R. I.
Curtis, Wm. R.
Dambach, C. O.
Danforth, G. H.
Deem, G. M.
Detwiler, U. G.
Dickson, F. W.
Dillon, S.
Dudley, S. W.
Dygert, H. B.
Dygert, W. B.
Edwards, W. A.
Emery, E.
Endsley, L. E.
Evans, T. J.
Farquhar, E. C.
Felton, F. J.
Frazier, E. L. Jr.
Fulton, A. M.
Gross, C. H.
Guay, J. W.
Heird, G. W.
Hill, J. F.
Howe, D. M.
Howe, H.
Huchel, E. W.
Huchel, H. G.
Hudson, W. L.
Hunter, J. A.
Hyndman, F. T.
James, J. H.
Kelly, H. B.
Knickerbocker, A. C.
Knight, E. A.
Koch, Felix
Koch, H. J.

Kummer, Joseph H.
Lanning, C. S.
Lanning, J. F.
Lansbury, W. B.
Laughner, C. L.
Lehr, H. W.
Lindstrom, Chas. A.
Lobez, P. L.
Long, R. M.
Low, J. R
Lyle, D. O.
Lynn, Samuel
Marcus, M.
Marshall, W. T.
McCauley, Wm.
McNulty, F. M.
Neal, J. T.
Newell, E. W.
Newburn, T. W.
Page, A. Jr.
Painter, Joseph
Parke, F. H.
Patterson, J. E.
Phillips, Lee
Richardson, L.
Richardson, W. P.
Richers, G. J.
Reymer, C. H.
Ritts, W. H.
Runser, K. W.
Saints, C. A.
Schaich, W. L.
Schauer, A. J.
Schultz, G. H.
Shaner, E. L.
Shaw, H. D.
Seewald, J. H.
Shadle, C. S.
Smith, F. C.
Smith, J. H.
Smoot, W. D.
Snyder, J. R.
Stafford, S. G.
Stark, F. H.
Stucki, A.
Suckfield, G. A.
Taylor, F. C.
Taylor, H. G.
Thomas, J. H.
Toomey, J. J.
Towson, T. W.
Trappe, W. C.
Travis, J. H.
Turner, Walter V.
Vowinkel, F. F.
Wagner, G. R.
Wardale, N. H.
Warne, J. C.
Watkins, G. H.
White, F. L.
Williamson, J. A.
Woermley, H. F.
Wood, V. V.
Wyke, J. W.

VISITORS.

Beaton, S. A.
Beeken, A. D. Jr.
Boetcker, Wm. J. H.
Bourne, G. L.
Brandt, E. C.
Bryan, J. H.
Calloway, B. G.
Cassidy, E. A.
Cato, W. C.
Chuptal, W. A.
Cox, E. M.
Cox, T. M.
Coyne, J.
Cunningham, C.
Ennick, H. M.
Fisher, H. L.
Foulk, E. A.
Geyer, A. M.
Gettinger, R. F.
Gowland, S. I.
Grieve, R. E.
Henry, C. O.
Herr, E. M.
Johnstown, W. R.
Judd, W. M.
Kelleker, Jas.

King, S. A. Jr.	Osbourne, A. S.
Larson, W. E.	Perry, J. H.
Lamon, J. A.	Rodgers, R. J.
Lewis, R. A.	Ryde, H. H.
McGee, Chas.	Snyder, J. C.
McGee, H. E.	Stenson, G. A.
Miller, R. N.	Stuart, J. A.
Morris, E. A.	Thomas, F. H.
O'Neil, J. Denny	Wallace, J. J.

Wright, J. B.

The minutes of the last meeting having been already published the reading of the same was dispensed with.

The Secretary read the following applications for membership:

Burson, H. W., President, Colonial Supply Co., Pittsburgh, Pa. Rocemmended by D. H. Amsbary.

Lacock, J. S., Salesman, Allis, Chalmers Manufacturing Co., 1209 Park Building, Pittsburgh, Pa. Recommended by John Pfeil.

O'Neil,J. Denny, County Commissioner, Pittsburgh, Pa. Recommended by D. M. Howe.

Rose, A. J., Assistant Superintendent, Greenville Steel Car Co., 74 Harrison Street, Greenville, Pa. Recommended by F. W. Dickinson.

Wolfe, L. L., Treasurer, American Spiral Spring and Manufacturing Co., 56th Street and A. V. Ry., Pittsburgh, Pa. Recommended by R. E. L. Bailey.

PRESIDENT: As soon as these applications have been favorably passed upon by the Executive Committee the gentlemen will become members.

PRESIDENT: If there is no further business we will proceed with the paper of the evening. We are to be congratulated in having Mr. E. M. Herr, President of the Westinghouse Electric & Manufacturing Company, as the speaker of the evening, who will present to us "Some Important Developments in Electric Power."

MR. E. M. HERR: Mr. President and Gentlemen of The Railway Club of Pittsburgh:—It is, I assure you, a very great pleasure for me to be here tonight. I regret that I have not

been able to give as much time to the preparation of this paper as I should have like to do. I had intended to have some lantern slides to illustrate some of the things I shall speak about, but absence from the city and the pressure of other matters made it impossible for me to arrange for the slides in time.

NOTES ON ELECTRIC POWER DEVELOPMENT.

By E. M. Herr,
President, Westinghouse Electric & Manufacturing Co.

The great development of electric power and its wide distribution and use in all kinds of service is largely due to the possibility of advantageously concentrating in one Central Station engines producing economically enormous amounts of this force, which is then cheaply and easily distributed over a great area and subdivided as minutely or in as large quantities as desired without great losses.

Thus the power of Niagara Falls is distributed throughout lower Ontario, Canada, on the west and western and central New York State on the east, over transmission lines extending to Lake Huron on the west and the City of Syracuse, New York, on the east, a total spread of about five hundred miles.

Prior to the development of the generation and transmission of electricity in large quantities, the prime mover, then consisting almost entirely of reciprocating steam engines, had to be brought to its work or the transmission of its power by means of belts or shafting and gears, at best confined to short distances, and accompanied by large loss of power. In mill work each load had its engine and the size of the engine was, of course, limited to the load available at that particular place.

So also in railroading, each load has its engine but here the amount of available load is not so much a limiting factor of the power of the engine as is the condition that each steam locomotive must take with it the boiler plant, including coal and water which supplies it, and all must be carried on a standard gauge track. In fact, great praise is due the skill and intelligent engineering development worked out by the locomotive designers that so much in the way of powerful locomotives has been accomplished with the extreme limitations

with which they are surrounded. Indeed the extent to which the power of the steam locomotive has been developed is nothing short of marvelous.

Due largely to the wonderful development in the steam turbine and its direct-connected electric generator, and the remarkably flexible, efficient and easy distribution of electricity, we are on the eve of a notable—in fact I believe an epoch-making change in the utilization of electric power.

First—The modern steam turbo-generator makes it possible to concentrate enormous amounts of power generation in one place.

Second—This makes possible and advantageous very large individual generating units. The growth in the capacity of generators has really been enormous, made possible by the steam turbine.

Third—Electricity can be transmitted long distances in large or small quantities and its characteristics changed at will, all with small losses and at comparatively low cost.

Previous to 1900 the reciprocating engine driving engine type generators was used almost exclusively—some tremendous units from the physical standpoint being used, as for instance the 7000 K. W. engine type generators installed by the Interborough Company of New York for operation of the Elevated Railway trains. The generators, connected directly to huge Corliss type engines, were forty-three feet high and compelled the Westinghouse Electric & Manufacturing Company, who built them, to install in a new shop a traveling crane set unusually high to handle them. In order that they could be shipped, these machines were so designed that they could be divided into several parts, each the limit of transportation on a large capacity freight car.

About this time steam turbines began to make headway as prime movers. I happened then to be in charge of the Works of the Westinghouse Air Brake Company at Wilmerding and had the privilege of purchasing and installing in the power house of the Company the very first direct connected turbo-generator ever installed in this country. This machine was of 500 H. P., built by the Westinghouse Machine Company, and is still in service.

The Westinghouse Machine Company and the Westing-

house Electric & Manufacturing Company were the pioneers in the field of direct connected turbo-generator manufacture and development in the United States and it was very largely through the remarkably vigorous exploitation and improvement of this machine by the eminent founder of the Westinghouse industries—Mr. George Westinghouse—that the progress seen today was made possible.

Soon 1000 to 3000 K. W. machines were developed and even sizes up to 5000 K. W. but this was then looked upon as extremely large and perhaps an abnormal size.

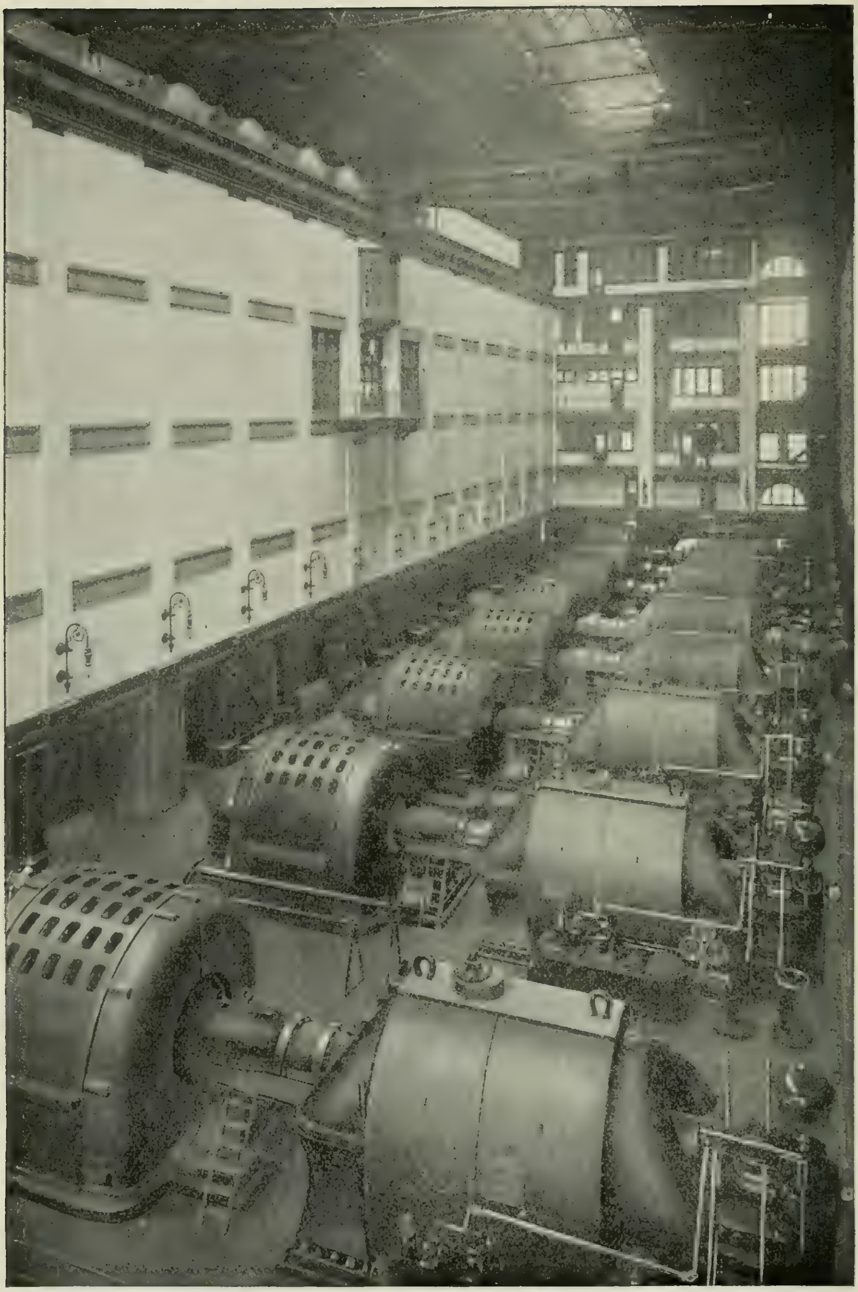
In the development of these turbo-generator units previous experience in the construction of engines and generators was set aside and designers had to grope their way along until they could accumulate enough experience to undertake bigger things.

The advance was steady and continuous so that by 1906 units of capacities equal to the largest engine type generators had already been built.

With increased experience the advance in size has continued until at the present time units of 30,000 to 35,000 K. W. are in operation and even much larger sizes, up to 50,000 or 60,000 K. W., are contemplated. Apparently the upper limit will depend upon the total concentration of power permissible in single units.

Increase in the size of power generating stations has kept pace with or gone beyond the increase of power in individual generating units. The capacity of steam boilers with modern stokers and forced draft has been wonderfully increased while the efficiency of the turbine has also been raised greatly by the use of highly superheated high pressure steam and the modern very high vacuum condenser.

All of this development has led to the reconstruction of power stations equipped with machinery still not old and in condition as good as new. Thus four of the large Interborough 7000 K. W. engine type units, above referred to, still as good as new, have recently been replaced by three 30,000 K. W. turbo generator units. These new units produce electrical power with a steam consumption of 8 pounds per H. P. hour against about 13 pounds per H. P. hour for the old units with reciprocating engines—that is, 90,000 K. W. of engine and generator capacity goes into the space occupied formerly by 28,000 K. W. and by



Westinghouse Turbo-Generators, With an Aggregate Capacity of 100,000 Kw., in the Kent Avenue Station of the Brooklyn Rapid Transit Co.

the use of new stokers, some changes in draft and the addition of superheaters, the same boilers furnish steam for 90,000 K. W. that formerly supplied but 28,000 K. W. This enables over three times the amount of power to be generated in the same space and at a very much lower cost.

We, therefore, see that at least two great gains have resulted from increased size of power stations—viz. improved efficiency and increased capacity. But this is not all. Improvement in *load factor* has also resulted.. This results from the increase in the diversity of service, making it possible to deliver a much greater total output with a given peak capacity.

The effect of improvement in load factor is cumulative, for not only the improved economy enables rates to be reduced but this reduction in rates increases the sale of power, again bettering the load and load factor and making still larger generating units possible with further increase in economies, etc.

Large stations can handle service which is impracticable for smaller stations, thus fluctuating loads too large for a small station may be entirely practicable when the station capacity is amply large. Steel mill electrifications, with their large motor units and more or less sudden changes in load, may be and are handled by a large power station.

The growth in size of electric power stations results not only in economy in their operation but also leads to the development and use of protective and safe-guarding apparatus. Many new problems in the control of the enormous amounts of energy distributed have arisen, as well as other problems in the safeguarding and protecting of the generating, regulating and distributing apparatus used. Thus a short circuit on a 100,000 K. W. power station may bring about conditions so severe as to be beyond the limitations of any known switching or protective apparatus. Such a short circuit for a moment may correspond to millions of horse power. Engines and generators may be wrecked, switchboards ruined, disastrous fires started and cables and feeders burnt. In order to prevent such occurrences, protective apparatus had to be and was developed to more than keep pace with that of power machinery so that now in a large station very large amounts of money may be expended in protective apparatus, normally inert but which comes into action when danger threatens.

The development and perfection of the modern large power plant increases enormously the advantages in the electrification of railroads.

The advantages and consequent progress in railway electrification are the second epoch-making development which is upon us and will be carried out as soon as financial conditions warrant. Before discussing this, however, just a word about two fields of activity which cheaper electricity and its production in large quantities enables us to occupy—viz.

First—The reduction of certain metals from their ores, either wholly or in part, as for example the production of aluminum and largely the refining of the high grade of copper known as electrolytic copper.

Second—The great and growing electro-chemical industry. A remarkable example of this art is the fixation of the nitrogen in the air, thus producing an extremely valuable fertilizer. As air is everywhere obtainable, this method enables enormous natural sources of power located in inaccessible places to be commercially utilized. The Rjukanfos plants in Norway, located where practically no electrical power is used for other purposes, have installed 175,000 KVA. of generating apparatus in one plant and 170,000 KVA. in another—a total of 345,000 KVA—all devoted entirely to the fixation of nitrogen and its conversion into fertilizer. Very large installations of this kind have been projected in North America, one of which provides a total capacity of over 500,000 KVA. It would thus appear that such plants may and probably will eventually far outstrip those for any other class of electrical service.

The use of electrical energy for heating in industrial processes such as the melting and refining of steel and for welding and forging operations is already, although in its infancy, making good progress.

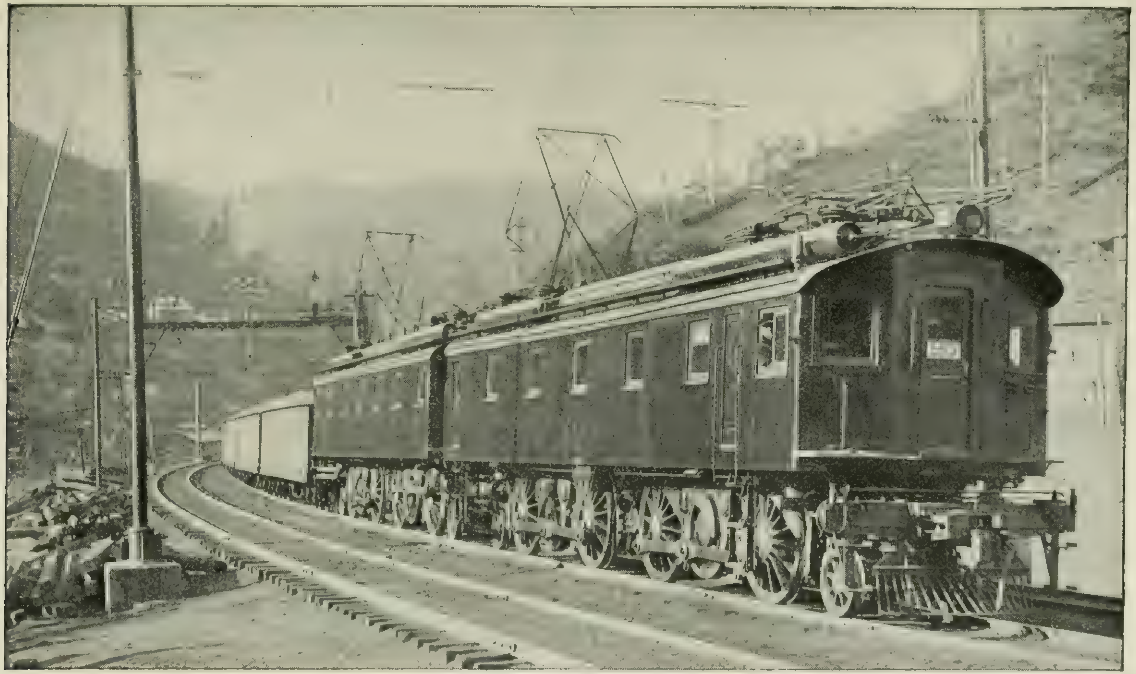
To return to the Electrification of Railways. This is no longer an experiment nor even in its infancy for much experience has been had and progress made in the ten years during which electrified steam railroads have been in actual operation. Fortunately, too, for this development, the installations first made were not all along similar lines, or, as it is usually stated, by the same system.

Originally it was thought electrification would be carried

out by either of two systems—the 600 to 700 volt direct current third rail or the high tension single-phase alternating current with overhead distribution. Experience has shown that the kind of current used and system of distribution employed are really engineering problems to be worked out by a careful study of each case and that each kind of current, whether D. C. or A. C., can advantageously be used in a variety of voltages and if A. C., either single or three phase.

It is fortunate that later developments indicate that the character of the contact device from which current is collected by the electric locomotive or motor car in main line service is now the same, regardless of whether the motors are direct or alternating current motors, or whether, if alternating, they are single phase or three phase induction type. This brings about a strong tendency to a standard and uniform design of exactly that part of the electric system that must be standard to interchange traffic with the least confusion and expense. Thus the Pennsylvania Railroad uses 11,000 volt single-phase current in the electrified zone in and about the Philadelphia Terminals. For heavy mountain grade service the Norfolk & Western Railroad found three-phase alternating current induction motors on their electric locomotives best suited to their requirements. The overhead distribution with single-phase 11,000 volt current is used on the Norfolk & Western Railroad exactly the same as on the Pennsylvania Railroad. This current, by means of a phase splitter on the locomotive, is converted into three-phase current and thus operates the three-phase induction motors on the locomotives. Should this system be hereafter decided to be best adapted to the mountain division of the Pennsylvania Railroad and the electrification at Philadelphia extended this far, no confusion will result as the single-phase and three-phase locomotives are both supplied with the same kind of current and voltage. When the mercury arc rectifier becomes commercial for large powers, direct current motors can also be used with the same distribution and contact system, thus making all three kinds of locomotives operative under the same overhead system.

By far the most extensive main line electrification thus far in the world is that of the New York, New Haven and Hartford Railroad. It has now installed 101 locomotives of all kinds and



Norfolk & Western R. R. Elkhorn Grade Electrification. A Baldwin - Westinghouse Electric Locomotive Hauling a Train of Coal Cars. Maximum Drawbar Pull 180,000 Pounds.

69 multiple unit cars. It has upwards of 500 miles of track electrified, including its Harlem Division Yards, among the largest freight yards in the world. Its electric locomotive equipment includes high speed locomotives for passenger service, large locomotives designed either for heavy freight or very heavy express passenger service and many slow speed switching locomotives especially designed for that service with control so nicely regulated that damage to cars and lading in switching service has been remarkably reduced.

The latest completed electrification is that of the Norfolk and Western Railway. This differs from the New Haven in being a mountain grade electrification for handling very heavy freight service on such grades almost exclusively. Here the locomotives are of very large capacity—in fact they are the largest locomotives, from the point of horsepower capacity, which have yet been built—either steam or electric.

In hauling the regular trains of 3250 tons on the Elkhorn grade of the Norfolk and Western Railway, which two of these engines—one at the head and one at the rear—handle, each develops in starting exceeding 6000 H. P. and about 3500 H. P. continually up this grade, hauling this load fourteen miles per hour or at just double the speed possible with three Mallet steam compounds formerly used. On four-tenths per cent grade these electric locomotives will develop at 28 miles per hour 4000 H. P. and again exceed 6000 H. P. in starting and accelerating.

This electrification is conspicuous in being the first in this country arranged to utilize the energy in the descending train to assist in hauling those ascending the grade. The characteristics of the motors on these locomotives are such that they automatically hold the train descending at almost exactly the speed at which they ascend the grade. This not only avoids the necessity of controlling the descending train by brakes but returns a considerable portion of the energy to the line.

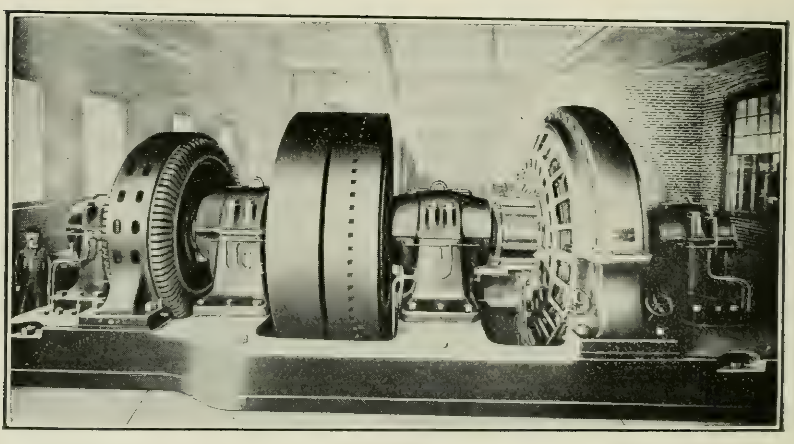
Large as are these Norfolk and Western electric locomotives, very much larger ones have been designed and will probably soon be built and put in service. Electric locomotives of 5000 or 6000 H. P. and even considerably more can be constructed when required.

Another very notable main line railroad electrification is that of the Chicago, Milwaukee and St. Paul, projected for a

distance of over 400 miles and of which about one-half is actually under construction. In this electrification direct current of 3000 volts will be used, distributed from an overhead catenary contact line very similar to the 11000 volt single phase contact lines. This electrification includes that portion of the Chicago, Milwaukee and St. Paul R. R. main line which crosses both the main range of the Rocky Mountains and the Wind River Range just east of the main range. The line is all single track with comparatively light traffic but will be equipped with electric locomotives of about 3000 H. P. each of which twenty-one engines for freight and passenger service are under construction.

Among the other large users of electric power are the modern steel mills. Here very large motors are used. Where ordinary mills use motors of hundreds of horsepower, steel mills require them of thousands of horsepower. Motors have been installed in some mills which can develop 8000 to 10,000 H. P. for hours at a time In some cases these motors are designed to take swings of from 10,000 to 20,000 H. P. for short periods and can reverse from full speed in one direction to full speed in the opposite in from five to ten seconds.

The induction motor has not itself the ideal characteristics for many kinds of steel mill work but its adaptability for large units appears to outweigh all disadvantages in most cases. In



Westinghouse Motor Generator Set Installed in the Plant of the Illinois Steel Co. Maximum Capacity 6500 Kw.

the reversing mill its disadvantages outweigh its advantages so that here it is simply used as a prime mover for operating more suitable types of generators and motors. In this case the induction motor drives a large D. C. generator, together with a fly wheel attached to it for carrying the fluctuations in load. This D. C. generator operates the roll motors.

The regulating properties of this combination are such that while the power for driving and reversing the rolls may vary from nothing to 10,000 or even 20,000 H. P., the induction motor driving the set will take up an approximately constant load from the supply system.

At light load the induction motor develops power which is stored in the fly wheel by speeding it up, while at peak load the fly wheel gives up this stored energy in parallel with the driving motor. Thus this reversing mill work, while extremely violent in itself, yet represents a fairly easy load for the power plant.

The third epoch-making electrical development now on the eve of general exploitation is the electric propulsion of steamships. The advantage of driving ships electrically arises chiefly through the large amount of power required to propel the enormous vessels now in general use both in the Navy and the general Merchant Marine. It will be seen, however, that this field is by no means limited to the large vesels but also has its application in those of moderate size. In large vessels so much power is required that the engines and boilers constitute a power plant of great size. For example, the larger war ships of the Navy require about 30,000 H. P. while some of the transatlantic liners in express service carry from 80,000 to 120,000 H. P., a new liner already designed and ready for construction being arranged for 180,000 H. P.

The advantage of driving such ships by means of electric motors arises from the much greater steam economy of the high speed steam turbine, direct connected to an electric generator, and at the same time the very decided decrease in weight per horsepower and consequently the space required for such machines when compared either with reciprocating engines or steam turbines, direct connected to the screw propeller which necessarily must be run at a determined and relatively very low speed. Not only is much weight and space saved in the engines, gen-

erators and motors themselves, but their much higher fuel efficiency enables fewer boilers to be installed and for a given steaming radius smaller coal bunkers and less coal, all increasing the freight or passenger carrying capacity, if a liner, or enlarging the armament or armor possible and increasing the steaming radius of the vesesl, if a man-of-war. Not only this but a most important advantage in naval vessels electrically driven comes from their superior maneuvering power. The electric motor has the advantage over the direct driven screw propeller in the quick reversal possible for this can be accomplished with full power and without reversing the prime mover.

In flexibility of operation and installation, the electric drive also has a decided advantage for there is no fixed relation between the number of generating units and engines and the number of propeller shafts. For high speeds all the engines and generators may be used while for slow speeds part of them can be shut down, thus operating the remainder at proportionally larger loads and consequent better efficiency. Again, the generating plant can be placed in any desired location without regard to the position of the propeller shafts.

On slow speed boats with smaller amounts of power required, the electric drive with steam turbo generators loses some of its advantages. Here the steam turbine of high speed, good economy and light weight may be more advantageously geared to the propeller shaft.

The invention and development of the Melville-McAlpine Reduction Gear made possible reductions in speed through direct-connected gear and pinion with single reduction from five to one to twenty to one and with double reduction from fifteen to one to one hundred to one and is capable of transmitting powers up to 20,000 H. P.

Prior to development of the Melville-McAlpine gear the use of gearing with high speed turbines was limited to small powers, enabling this method to be considered on only about three percent of the vessels in the Merchant Marine. Removing this limitation, which the Melville-McAlpine invention does, opens practically the entire marine field for the high speed turbine, either geared or connected electrically to the screw propeller shaft.

The advantages of oil engines of the Diesel type in this

field must not be overlooked for here again the electric drive becomes attractive and advantageous. The Diesel type engine and generator, requiring only oil for fuel, at once eliminates the space occupied and weight of boilers and coal, to say nothing of condensers, pumps and other auxiliaries incident to boiler and condenser installations. These engines, for the greatest economy and lightest weight, must run at speeds too high to admit of direct connection to the propeller shaft. Oil engines with large cylinders are not only heavy and cumbersome but do not give as good results as smaller higher speed engines. It thus becomes advantageous to divide the engines into a number of units. These units, however, many of whatever size or wherever located in the vessel, when supplied with direct connected generators, are easily tied together electrically and handled as a unit or divided as desired to actuate suitable motors on the propeller shafts.

It is thus easy to understand the wonderful flexibility and simplicity which the use of electricity as a means of transmitting power effects in this kind of an installation, making easy of accomplishment an otherwise impossible problem.

This review shows the paramount advantage of the high speed engine—either steam turbine or of the internal combustion type. These very efficient prime movers could, however, not be utilized were we not able to convert efficiently their mechanical power into electricity which, by virtue of the wonderful property possessed by it alone of coupling or tying together any number of generating units, however located, and transmitting their combined energy over long or short distances with almost negligible losses, may finally, after whatever subdivision is desired, with great efficiency again be changed to any form of energy desired for the benefit or comfort of man; thus giving him at will light, heat, chemical energy or mechanical power.

In conclusion, owing to the great advantage of the use of large turbo-generator units and their concentration into Central Stations of very large size, we shall see a rapid extension of the application of electric power to all advantageous used and especially to the electrification of railroads. We are also entering upon an epoch-making change to the electric propulsion of steamships, both merchant and naval.

PRESIDENT: The subject is now open for general discussion. Mr. Stucki, may we hear from you?

MR. A. STUCKI: I do not see why the President should pick on me. The reason I came over tonight was because I expected an unusually good paper and we certainly got it.

I noticed that Mr. Herr said he did not have much time to prepare the paper and this is undoubtedly the reason he didn't prepare a few lantern slides to show the things he was telling us about. Therefore, if not asking too much, I would suggest that a few slides be added when the paper is being printed, so as to make it that much more comprehensive. A turbo-generator, an electric lomotive and the arrangement of motors, flywheels and generators for severe rolling mill conditions would possibly be sufficient.

I was especially much interested in what was done on the Norfolk & Western and in railroading in general. We all remember very well the time when cables were in vogue. It was considered a great advantage that the car going down a hill was pulling on the cable, helping thereby the other car which was going up the hill, and conditions from a power standpoint were pretty nearly ideal had it not been for the tremendous friction caused by dragging miles of these heavy cables over hills and around corners. Now it looks very much to me as if we have come back to the cable road without the friction.

MR. A. E. ANDERSON: About ten years ago at a meeting of the Engineers' Society I remember that this same subject, substantially, was presented, and in the discussion of the paper a gentleman, and I think he was a Westinghouse man at that said that in ten years the steam locomotive would only be visible in museums. Since that time, and during these ten years, as the speaker has said, the locomotive has been practically revolutionized, and what would have been unbelievable ten years ago is being accomplished every day. Also the electric world has been practically revolutionized. I was hoping the speaker would go a little farther in his remarks on this race between steam and electricity and give us a comparison of this race between these two branches of transportation engineering. It was the prophecy at that time that electric transportation would drive the steam transportation off the rails, whereas the fact is that the locomotive is fairly holding its own and in a

good many respects it is a question whether electricity will ever drive it off the rails. For the big improvement they are working out now is the problem of using powdered coal in the locomotive, which will improve the utilization of the heat units of the coal in a way that has never been done before. The trouble and expense in locomotive practice has been that they could never get more than 5 to 10 percent of these heat units, and at the last convention of the fuel men at Chicago they showed that the use of powdered coal was going to be a real advance. I would like to ask the speaker for a little information as to which side will eventually win this very interesting race.

I would also like to ask for the benefit of myself and others that he give us a plain and untechnical definition of the term "phase."

MR. STUCKI: I would also like to ask Mr. Herr for additional information regarding end shocks, and especially whether the cars cannot be handled with more care since the electricity is under absolute and instantaneous control. This is very important for the rolling stock, and if correct, will be a big factor in favor of the electric locomotive. Mr. Herr already stated that in an electrified switching yard less trouble was experienced in this respect.

MR. J. G. CODE: There is an electric railroad operated in Montana about which I would like to hear something. It is older than the Norfolk & Western and under at least as severe grade conditions. I refer to the Butte, Anaconda and Pacific, operating between the Butte mines and the smelters at Anaconda. I know something of the service years ago under steam operation and I would like to hear something as to the electric operation which has been in effect long enough to get considerable results.

MR. W. H. RITTS: I would like to ask if the losses are comparable between the three types of motor Mr. Herr spoke of, comparing the D. C., the single phase distribution supplying a three phase motor and the three phase distribution supplying a three phase motor.

PRESIDENT: There are some gentlemen here from the Westinghouse Companies and we ought to hear from them in this discussion. Mr. Herr referred to air brakes in his paper

and I notice Mr. W. V. Turner in the audience, we would like to hear from him.

MR. W. V. TURNER: I do not know that I can discuss this subject very much from a power standpoint, but since it was suggested that there might be something in it from the standpoint of the air brake I might be privileged to say a few words. But before doing that I would like to say what impressed me more than anything else in the paper is the really wonderful work that is going on, and to a very great extent absolutely unthought about by the rank and file of our membership, including myself. When we consider such a paper as this it would seem how small a part most of us play in the actual development of civilization, so to speak, of the progress that makes up what we know as civilization. I presume not more than a thousand out of the many millions in this country had anything to do with the development of this wonderful multiplication of power units, though all of us realize the importance of such men capable of combining human faculties and physical laws to cheapen the production of power to such a degree as has been stated tonight, which means the cheapening of all that goes to make up our life of today. We should all pay tribute in some way or other to the men who exercise their faculties along the line of developing such wonderful things as we have heard about tonight. I think we give far too little recognition to the men who give their wonderful talents, their study, and the sacrifice of their time and often their health to bring about such wonderful things as these by which we all benefit and benefit so indirectly that we hardly realize where it comes from or the true cause of it.

Now with regard to the paper itself, another thing which impressed me was a statement which I have very seldom heard. Most people seem to think that the increased capacity of a railroad such as the New York subway is due to some direct advantages of the electrification of railroads or other things. As a matter of fact it is altogether, or so nearly so as to leave only negligeable quantities, due to indirect things, to matters of convenience and large units and getting underground, where otherwise you could not go for smoke and gases and other things. It is these that make electricity such a wonderful improver and increaser of traffic.

I think Mr. Herr overlooked one thing in the paper. He did not speak of the use of electricity for braking purposes. He is more concerned in the development of power or energy. Now it would be a mighty unsafe thing to develop such wonderful units as he speaks of unless there was some way of dissipating it after it is induced. It may surprise some of you gentlemen to learn that the use of electricity for railroading not only will double and triple the capacity as far as the motive power itself is concerned, but the use of electricity in braking the trains or for braking purposes will again double the capacity of any railroad in this country today. It will in other words be useful in two ways. First you can get twice as much out of the road by using electricity as power, and you can get more than twice as much out of it by using electricity as a means for applying and releasing the brakes. I can not go into it far enough to tell you at this time how it is accomplished, but as a matter of fact the increase in capacity has been more than doubled by the use of electricity.

And as pointed out, how it can be done in two ways. First the ability to control a train in the shortest possible time and distance is dependent upon one of two things, and then both of those two things together. You might say first that it is dependent upon the condition of the rail, just as the generation of horse power is or the tractive effort. And that primarily is the case. But we have never been able to utilize but a small fraction of that for the reason that the length of the train has got so much to do with it that if we develop the rate of retardation more than .65 percent per second with an 8 or 10 car train the difference in retardation between front and rear at a given moment is so great that severe shocks are produced, making it prohibitive to use anything like the capacity of the rail for retarding purposes. But when you use electric operation or transmission you can apply the brakes at a rate of 35 percent per second if you care to. Thus the retardation you can set up is so much greater that the stopping distance can be much shortened.

But another thing is possible. You can increase the retarding force up to the full capacity of the rails or as much as you think wise or permissible to avoid wheel sliding, and so you can use any retarding force practicable and at least twice as

high as you could employ if you used pneumatic transmission for your brakes. Not only that, but the length of train that you can use an efficient pneumatic brake on is limited to possibly six cars where you have a standing load, or if the cars are so loaded to any degree, because you would upset people and damage suits would result from injuries. But with electric transmission you can apply the brakes without fear of jerks or damage to *any* length of train and thus you can run 10 or 12 car trains if the platforms are long enough, and by that means double the capacity of the road. In fact, as we have the old standard pneumatic and the present electric transmission in existence today, the number of trains that can be run over a given track or the proportion of people that can be transported is as 3 to 1. It is, in other words, possible to take three times (or more) as many people over the same piece of track with the electric application of brakes as you can with the pneumatic brakes alone. An example of that is in New York City in the new municipal subway that is being built there where they believe that by the use of electricity for braking purposes they expect to do with 10 trains the work that previously required 48 trains to accomplish. That gives you some idea of what electricity is doing not only with regard to the use of electric energy as applied to propulsion but also what it means in regard to the stopping of trains.

With regard to regeneration, that is putting current back into the line, I expect to see some very wonderful developments of that in the very near future. For instance there is in a train today, disregarding the waste from the power house and the small losses due to journal resistance and wind resistance, etc., practically all the energy that came from the power house. Today what do we do with it? When we use it to the utmost which can be done through electricity to increase the capacity several times, it is still waste energy, it has gone out as heat into the atmosphere, it is dissipated. There is no reason for this except the fact that the human faculties at the present time have been too limited in their knowledge or adaptation to things that exist to turn that energy from the brake into the line. With the exception of some small amount at the finish of the stop, practically 75 to 80 percent of all the power generated at the power house will some day be turned back into the line, so that the

net cost instead of being 100 percent of that power developed at the power house will not be over 25 percent for operating trains. That will give you some idea of what the future holds in store for us. To some extent that answers Mr. Anderson's questions.

There is one thing which Mr. Herr did not touch on and which must be used in connection with regeneration, it must be so coupled up with the brakes that in the event of the wire which connects the motors back into the line burning out or in any way becoming disconnected, such as the trolley off, that the brakes will immediately take hold of the train and control it. That will be necessary to avoid accident or damage in any way. There is no development of which I know at the present time which permits of any retardation being set up in that locomotive if the connecting wire to the line should break.

Another thing that must be done in connection with the regenerative system, as I see it, is that the speed on down grades must not be permitted to exceed that for which the brakes are capable of controlling it. If the brakes are good to control it at 14 miles per hour, the speed must not be permitted to exceed 14 miles per hour. If it gets to 20 and you should lose the straight air brake (regeneration) the train would be beyond control. And if attempt is made by the engineer to exceed that limit at which the brakes will control the train, the brakes must automatically apply and prevent it. So that while Mr. Herr and his engineers are working on the development of the electric mechanism for use on railroads for acceleration, we are also working just as earnestly and as hard on the side of deceleration or retardation.

PRESIDENT: Professor Endsley, may we hear from you?

PROFESSOR L. E. ENDSLEY: I had the pleasure about three months ago of spending three days on the Norfolk & Western at Bluefields where this new electrification is going on, and to stand there and see those electric locomotives go up the hill so easily, and see the steam locomotives make such a noise about it, I was somewhat impressed with the electrification idea and wondered if I would not like to change off and do a little electric work.

This subject of regeneration which does away with all hills,

is very interesting. When that time arrives, we will only have to supply the power necessary to move the train on a level road as all current put into the train going up the hill will be taken out coming down and in this way the hills and hollows will all be done away with and we will not have to cut down hills and fill in the hollows because we can store up the energy and take it out again. That is quite a problem and will be a great accomplishment and when it is worked out, we shall have Mr. Stucki's cable running over all the long hills with very little friction. I am glad tonight that Mr. Stucki and I are on the floor without friction.

PRESIDENT: Is there any further discussion? If not I will ask Mr. Herr to reply and close the discussion.

MR. E. M. HERR: There have been so many interesting questions asked that if I do not answer them all I shall be glad to be reminded of any omission.

In regard to likening the regeneration to the cable without friction, it is not absolutely without friction. There are some losses that the cable does not make. And while I am upon the matter of regeneration, Mr. Turner has hit the nail upon the head in his statement that there are just as large savings to be made in deceleration of trains as in the acceleration of them. In fact the laws are exactly the same, and, barring losses, it ought to be just as possible to save in stopping trains and the conversion of that energy back into useful energy, as there is in actual acceleration.

As to the likening of the regeneration to the straight air brake the point is a good one. It is true that if the engine lost the trolley there would be no regeneration and it is not at all supposed that this brake takes the place of the brakes on the train. The brakes have got to be there and it would be an admirable thing to couple them up as Mr. Turner suggested so that in case an accident happens the brakes automatically apply.

As to the possible danger of the train getting out of control by the engineer allowing it to go faster than 14 miles an hour, or whatever speed may be at which regeneration is produced, that is not possible. By virtue of the properties of these motors they must run at exactly the same speed, or within a very small fraction of the same speed, in regeneration. If they

do not run at that speed they do not regenerate. If they exceed the speed a very small fraction that motor will actually stop. It simply blocks. It either holds it at that speed or it does not hold it at all.

There is another safeguard in the regeneration matter, especially on these very heavy grades. These trains are rarely if ever put up with one engine, so that in coming down there are two engines and if one loses the trolley the other will hold the train. If you were regenerating on the head engine and it lost its trolley, when the slack ran out the train would break in two and that would automatically set the brakes in emergency.

Mr. Anderson asked several questions that I will try to answer. He asked what the word phase meant. It is pretty difficult to explain that to a non-technical audience. If I attempted to explain it to a technical one they would call me down, because I do not profess to be an electrical expert myself. The ordinary alternating generator generates three phase current. That means that if you had to transmit that current it would require three wires, three conductors. You ordinarily see an A. C. current transmitted with two wires and a ground return, or three wires if all these phases are wired. With a single phase you only require a single wire. That is, the generator, gives you three alternations in a revolution of the armature. Each of those has to have a conductor to take it off. In a single phase conductor you only take off the current generated in one phase. It only requires a single conductor. That is why the alternating current is generally taken single phase instead of three phase, for with three phase you have three conductors and that enormously complicates the system because each one has to be insulated from the others just as much as from the ground, because the ground is the third phase. We ordinarily use one phase current in electric power. That is not always the case. In Italy railways are electrified with three phase current having three phases of transmission, using two overhead conductors and the trolley arranged to collect the two phases and transmit them to the three phase motors. In yard work that becomes very complicated. In America with our very much more comprehensive systems and larger yards that has not been thought to be good engineering, so we have not exploited the three phase system here.

The three phase motor has particular advantages in heavy railroad work, partly because it is extremely rugged and with very great difficulty is damaged by over load or rough handling, and principally, perhaps, because it has this property of regeneration without any complications, so that it is very desirable in heavy grade work.

Mr. Turner spoke of the wonderful results that have been obtained by these technical men who have worked all these things out. I am glad he spoke of that. It is something that we should all consider. How remarkable it is that men can sit down and by the power of their intellect devise and work out these tremendously intricate problems and bring them to a successful utilization for the service of man. And that is what has been done so wonderfully in the development of the air brake and its subsequent combination with electricity to produce even more wonderful results than have been produced pneumatically.

Just one of those remarkable things has been done in so arranging matters that a single phase transmission, with all its simplicity, and advantages, can be used and still retain the great advantage of these three phase motors for heavy mountain work. The only complication that has been brought in to bring that about has been the device on the locomotive which I have called the phase splitter, which is nothing more or less than a rotating device a good deal like a commutator, which changes this single phase current and splits it up into three phase current when it flows to the motor and actuates that with all the advantages that would be gotten from the great complication of the double wire trolley system.

As to the time when the electricity is going to supplant the steam engine altogether, none of us will ever see it. I do not look for the time when the steam locomotive will be supplanted entirely by the electric locomotive, not within the purview of anybody present and possibly not for generations and may be never. But we will all see a very great development in the utilization of electricity in railroad work. Electricity is not adaptible to all railroad work. There is a great deal of railroad work where steam locomotives will do far better than electric locomotives. And that works out especially in parts of the country where the traffic is comparatively thin and where it

fluctuates enormously from season to season. The steam locomotive is so admirably adapted to the fluctuating character of the traffic on many of our railroads because you can run a lot of them and concentrate them on a certain division and then distribute them on several divisions and you can get a utilization of all your power at any point on your line where it is desirable to have it concentrated. If you have electric motors installed you have to install for the maximum traffic, and the cost of that investment depreciation and charges goes on whether you have traffic or not. The steam locomotive is not going to pass away, and I do not wish you to think that I intended to give that impression. It is an engineering problem, as I said in the paper, and should be studied with the greatest care by men who are competent to deal with a problem of that sort. And any one who wishes to know whether electricity is applicable to any particular case has got to get in some experts and make them prove their case. It can be done. It either is justified or it is not justified, and it has got to be put right on an engineering basis.

I was asked as to the Butte, Anaconda and Pacific electrification. That has been in service for several years and is operating I understand with great success. The electrification there is direct current 3000 volts distributed on a catenary overhead line very similar to the overhead line that distributes a single phase system. But it is not as high voltage and the locomotives are not as powerful on that line as on the Norfolk & Western and some other of the heavy mountain lines. They do handle traffic under quite as adverse conditions as to grade, but they do not handle it in quite as large units.

Mr. Stucki asked about the handling of lading and the more economical switching due to the fact that electricity is better under control than steam. That is a fact. It does work out that way. Of course it may be objected to that statement is rather a broad one and probably not entirely correct. What I mean to convey is this. We all know that in a steam locomotive the power is produced by reciprocating action of the piston, and that has to be geared into the rotation of a driving wheel from which you get the traction. That combination unavoidably produces an unequal turning moment or torque of the wheel and it is very easy for a locomotive engineer if he gets his wheel

in a position where the turning power is at a minimum and the engine does not start promptly, to open the throttle to get her over that point, and when he gets it open he can not instantly close it again and you get a pretty hard shock. With the electric locomotive the turning moment is absolutely uniform. Wherever you turn the current on you get exactly the same results from a given amount of current, no matter how the wheels may be situated with reference to the engine. And also due to the fact that the current is under very quick and prompt control you can put the current on and in the merest fraction of a second you can take it off, and it enables the control of the engine to be a little better manipulated than a steam engine. That is not entirely a theoretical statement because the New Haven road have told us that they find a great difference in the damage done to cars and lading in their Oak Point yards since the electric switch engines have been working and the steam switch engines have been entirely eliminated.

There was one other question as to the difference in characteristics of these motors, single phase, three phase and direct current. There is practically no difference in the losses in transmission or conduction to these motors. That is not where the difference comes in. The difference arises more in this way. Any of those motors can be made of about equal efficiency, but with a given weight and given dimensions the D. C. motor has more power than the single phase motor, and the three phase motor has about the same power as the single phase motor or probably a little more for a given weight. But its particular advantage is its extreme ruggedness and this property of regeneration without additional complication. You can get regeneration with a D. C. motor but you have to go through considerable complication to get it. There are developments going on that may simplify that. But the difference in those three systems does not arise from the fact that one has less losses than the others, because that part is almost negligeable. But there is quite a difference in the D. C. motor and quite an advantage in the amount of power per pound weight of motor. I should also state that to provide D. C. current a rotary transformer or equivalent is necessary, for economical transmission over long distances high voltage A. C. current must be used.

MR. CODE: I am reminded a good deal of an old time

General Superintendent who when they undertook to explain to him the advantages of the compound engine, that it used the steam over again, said "That looks too much like getting something for nothing, and I never saw that yet." The old man was quite a character had come up from the track, honest, full of common sense and a good judge of men, above all. He had occasion one time to appoint a division superintendent. He selected a very bright young man from the mechanical department and sent him down there. The new man was not quite so sure of himself as the old man was of him and asked for advice. He was a little doubtful about the new job and what he should do. The old man said "Things are running down there, are they not?" "Oh yes." "Let them run. Don't try to stop them." The superintendent made good, and he has made good ever since. He has continued to make good and he has given to us a very interesting paper this evening, and I move a rising vote of thanks from the Club to Mr. Herr for his paper.

MR. HARRY HOWE: I do not wish to usurp the function of some of the older officers of the Club, particularly my illustrious adopted father, but I would like to second that motion. You have heard a masterly paper presented in a masterly way, and I would like to include in that motion, if Mr. Code will permit me, a vote of thanks also to Mr. Turner, who brought out some points that were not exactly overlooked but that needed a little emphasis. I would suggest that Mr. Turner be included in the motion.

MR. CODE: I do not like to encourage Mr. Turner too much, but I will accept the amendment.

The motion prevailed by unanimous rising vote.

PRESIDENT: With this meeting we close for the summer months. I trust you will all enjoy your vacation, and we hope to see each and every one of you here on the night of our next meeting, September 24th.

We have luncheon as usual. If there is no further business, a motion to adjourn will be in order.

ON MOTION, Adjourned.

J. B. Anderson
Secretary.

RAILWAY CLUB NOTES.

The following subjects were presented and discussed by the several Railway Clubs during the month of May as noted below:

New York Railroad Club, Harry D. Vought, Secretary, 95 Liberty Street, New York.

SUBJECT: Qualities of Good Steel Rails—by Gustave Lindenthal.

Central Railway Club, Buffalo, N. Y., Harry D. Vought, Secretary, 95 Liberty Street, New York.

SUBJECT: The Locomotive of Recent Developments—by S. S. Riegel, Mechanical Engineer, D. L. & W. R. R.

St. Louis Railway Club, B. W. Frauenthal, Secretary, Union Station, St. Louis, Mo.

SUBJECT: St. Louis' Unmet Educational Needs—by Dr. John W. Withers.

New England Railroad Club, Wm. E. Cade, Jr., Secretary, 683 Atlantic Avenue, Boston, Mass.

SUBJECT: Developments in Oxy-acetylene Process—by Henry Cave.

Western Railway Club, Joseph W. Taylor, Secretary, 1112 Karpen Building, Chicago, Ill.

SUBJECT: Annual meeting.

Canadian Railway Club, Jas. Powell, Secretary, Chief Draftsman, G. T. R. Montreal, Canada.

SUBJECT: Annual meeting.

Richmond Railway Club, F. O. Robinson, Secretary, In care of C. & O. Ry., Richmond, Va.

SUBJECT: Safety First—by George Bradshaw.

Southern & South Western Railway Club, A. J. Merrill, Secretary, Box 1205, Atlanta, Ga.

SUBJECT: Mikado Type Locomotives—by Mr. Kline.

Copies of the above papers can be had upon application to the Secretary at the address given, for a nominal price.

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"TRANSPORTATION IN ALASKA"

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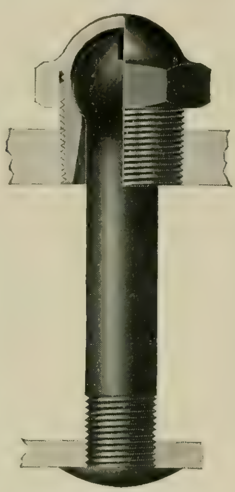
The Pennsylvania State College.



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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING, SEPTEMBER 24, 1915.

The regular monthly meeting was called to order at the Monongahela House at 8 o'clock, P. M., by President F. M. McNulty.

The following gentlemen registered:

MEMBERS.

Ainsworth, J. H.
Allison, John
Amsbary, D. H.
Anderson, A. E.
Anderson, J. B.
Ashley, F. B.
Babcock, F. H.
Barth, J. W.
Battinhouse, J.
Batty, John
Blair, H. A.
Boehm, L. M.
Bohannon, G. L.
Boyer, Chas. E.
Brandt, E. K.
Braun, Otto
Brunner, F. J.
Bugle, G.
Calvin, A. W.
Chapman, B. D.
Chester, C. J.
Clark, C. C.
Cline, W. A.
Code, J. G.
Cooper, F. E.
Cooper, J. H.
Cooper, Wm. M.
Copeland, T. T.
Cornelius, R. D.
Courtney, D. C.
Croft, E. P.
Cunningham, R. I.
Dalton, C. R.
Dambach, C. O.
Deagan, J. J.
Deane, Robt.
Deem, G. M.
Falkenstein, W. H.
Farquhar, L. C.
Fettinger, H. O.
Fitzgerald, D. W.
Forcier, C. W.
Forsythe, Geo. B.
Fulton, A. M.
Gale, C. H.
Geddes, Jas. R.
Grewe, H. F.
Guay, John W.
Harsch, A. M.
Haynes, J. E.
Heird, Geo. W.
Herrold, A. E.
Hershy, J. E.
Hill, J. F.
Hoffman, C. T.
Holbrook, W. H.
Howe, D. M.
Howe, H.
Huchel, H. G.
Huff, Geo. F. Jr.
Hunter, J. A.
James, R. E.
Kelly, H. S.
Keptner, J. B.
Kinch, L. E.
Knickerbocker, A. C.
Klein, R. A.
Knight, E. A.
Knight, E. H.
Lanahan, Frank J.
Lanahan, J. S.
Lanning, C. S.
Lanning, J. Frank
Lansberry, W. B.
Laughner, C. L.
Lidstone, F. J.

Lindner, W. C.
Lobez, P. L.
Long, R. M.
Lynn, Saml.
Mahley, C. G.
Marcus, M.
Marshall, W. T.
Mensch, E. M.
Milligan, E.
Mitchell, A. G.
Mitchell, John
McCollum, G. C.
McDonnell, F. V.
McFarland, H. L.
McIntyre, G. L.
McKinstry, C. H.
McNulty, F. M.
McVicar, G. E.
Neal, J. T.
Newell, E. W.
Painter, Joseph
Patterson, J. E.
Penn, Wm.
Phillips, Lee
Phillis, W. A.
Porter, H. V.
Proven, John
Pulliam, O. S.
Rabold, W. E.
Redding, D. J.
Richardson, L.
Richardson, W. P.
Ridley, R. C.
Riley, J. W.
Ryan, Wm. F.
Sattley, E. C.
Schaaf, A. J.
Schaich, Wm. L.
Scheck, H. G.
Schultz, George H.
Shadle, C. S.
Shaner, E. L.
Shaw, H. D.
Shourek, T. L.
Sleeman, W. C.
Smith, J. H.
Smoot, W. D.
Snitzer, N. E.
Snyder, J. W.
Stark, F. H.
Suckfield, G. A.
Summers, J. M.
Taylor, F. C.
Thomas, J. H.
Vowinkle, F. F.
Wardale, N. H.
White, F. L.
Williamson, J. A.
Woernley, H. F.
Wyke, J. W.
Yungbluth, B. J.
Zinsmaster, F.

VISITORS.

Anderson, R. I.
Arnold, J. G.
Ashton, H.
Botsford, C. F.
Bosley, N. D.
Brandt, E. A.
Calvin, G. G.
Clarke, J. J.
Code, Chas. J.
Davis, A. G.
Desoe, E. G.
DeBrun, J. M.
DuBarry, E. G.
Fields, A.
Fobb, J. W.
Graham, Russell
Grieve, R. E.
Hamilton, Wm. H.
Haynes, F. L.
Horton, Jas.
Jacobs, C. F.
King, S. A. Jr.
Laughlin, J.
Lonie, J. H.
Martin, Dr. P. A.
Maxwell, F. R.
Meihner, G. F.
McArdle, W. P.
McCormick, C. C.
McMichael, F.

Noah, W. J.	Sprague, L. C.
Patton, J. G.	Stewart, E. E.
Rawlins, H. A.	Swartzwilder, R. C.
Shannon, Chas.	Wagner, E. A.
Shepard, V. J.	Walkeld, G. G.
Sleeth, J. H.	Wharton, J. E.
Snyder, R.	Whitmore, H. N.

Wilder, H. W.

The calling of the roll was dispensed with, the attendance being recorded on the registry cards.

The reading of the minutes of the last meeting was dispensed with, the proceedings having been published.

The Secretary read the following list of applications for membership:

Botsford, Clarence F., 226 East Eighth Avenue, Homestead, Pa. Recommended by W. B. Lansberry.

Clark, W. M., Master Carpenter, B. & O. R. R., 4790 Sylvan Ave., Pittsburgh, Pa. Recommended by Gus Sigafoos.

Davis, A. G., Secretary and Auditor, P. A. & McK. R. R., McKees Rocks, Pa. Recommended by Harry Howe.

Ewing, G. L., G. L. Ewing & Bro., Homestead, Pa. Recommended by W. B. Lansberry.

Geary, J. J., Representative Homestead Gas & Electric Co., Eighth Avenue, Homestead, Pa. Recommended by W. B. Lansberry.

Goodwillie, E. E., Representative Penna. Steel Co., Oliver Building, Pittsburgh, Pa. Recommended by H. V. Porter.

Graham, Russell, Draftsman, Pressed Steel Car Co., 99 Grant Avenue, Bellevue, Pa. Recommended by Harry Howe.

Hankele, E. W., Civil Engineer, Penna R. R., 1003 Penn Avenue, Pittsburgh, Pa. Recommended by R. A. Klein.

Harper, Robert C., Head of Blue Print Dept., Pressed Steel Car Co., Pittsburgh, Pa. Recommended by Harry Howe.

Kenney, R. W., Salesman, A. M. Byers Co., 235 Water Street, Pittsburgh, Pa. Recommended by J. B. Anderson.

Lockwood, Chas. H., Draftsman, Pressed Steel Car Co., 336

Lincoln Avenue, Bellevue, Pa. Recommended by Harry Howe.

McGhee, W. S., Manager, Enterprise Stamping Co., McKees Rocks, Pa. Recommended by F. H. Babcock.

Pennepacker, N. W., Motive Power Inspector, P. R. R., Twenty-eighth and Liberty Avenue, Pittsburgh, Pa. Recommended by George F. Huff, Jr.

Rehlin, T. G., Draftsman, Pressed Steel Car Co., 3424 Fleming Avenue, N. S., Pittsburgh, Pa. Recommended by Harry Howe.

Snyder, Rudolph, Enginehouse Foreman, P. R. R., 600 Brownsville Road, Mt. Oliver, Pittsburgh, Pa. Recommended by H. G. Scheck.

VanDalsem, G. A., Draftsman, Pressed Steel Car Co., 817 Tenth Street, West Park, McKees Rocks, Pa. Recommended by Harry Howe.

Wilder, H. W., Draftsman, Pressed Steel Car Co., 931½ Woodward Avenue, McKees Rocks, Pa. Recommended by Harry Howe.

Williams, Alan G., Assistant Master Mechanic, Penna. Co., 6941 Prospect Street, Ben Avon, Pittsburgh, Pa. Recommended by F. V. McDonnell.

Wegener, Henry, Car Foreman, W. P. Ter. Ry., No. 1 Moffat Street, East Carnegie, Pa. Recommended by C. O. Dambach.

PRESIDENT: As soon as these names have been approved by the Executive Committee the gentlemen will become members

The President appointed the following Nominating Committee on Officers for the ensuing year and requested them to report before the close of the meeting:

D. M. Howe, Chairman
W. L. Holbrook,
H. G. Scheck.

The Secretary announced that he had received information of the death of the following members since our last meeting:

J. E. McGough,
W. A. Smith,
O. P. Meckel,
E. M. Grove.

PRESIDENT: It is customary to insert in the Proceedings obituary notices of deceased members, and an appropriate memorial will appear in the next issue of the Proceedings.

PRESIDENT: If there is no further business, the next in order is the paper of the evening, which will be presented by Dr. W. R. Crane, Dean of the School of Mines of The Pennsylvania State College, on the subject "Transportation in Alaska," illustrated by lantern slides, showing the character of the country, proposed railway routes, other means of transportation, and additional information of interest.

DR. W. R. CRANE: Mr. President and gentlemen of The Railway Club of Pittsburgh:—It is needless to say that I am pleased to be with you tonight to give you some idea of Alaska and of its great possibilities.

TRANSPORTATION IN ALASKA.

By W. R. Crane,

Dean, The School of Mines of The Pennsylvania State College.

The development of a country depends very largely upon its accessibility either by land or by water. A sea-board is of prime importance as it permits trade with the whole world, but without adequate facilities for communicating with the interior as by river or railroads little material development may be expected throughout the country as a whole.

Construction of suitable roads is of great importance for the development of the Territory of Alaska, and while conditions there are not radically different from those to be found in other new countries yet there are conditions that are peculiar to the Territory. In the first place there are few good harbors, which may seem strange to one not familiar with the facts and who has only the rugged coastline of the country in mind. There are numerous bays but very few of them are so located as to be readily accessible from the interior, nor are they suitable for the trans-shipment of freight such as coal and ore, as they are often undesirable for dock construction under existing conditions of high tides, ice and extensive shoaling. Further, several of the most advantageously situated harbors cannot be used owing to their exposed position. Others are rendered inaccessible

throughout the greater part of the year, being ice-bound, which is particularly true of the Bering coast as far south as Bristol Bay, and Cook Inlet above 60 degrees north latitude.

The mouths of all the large rivers of Alaska are shoaled to a remarkable extent, which is particularly true of the Yukon, the Kuskokwim, and the Copper River. However, beyond the great mud-flats, through which uncertain and ever shifting channels occur, broad expanses of navigable waters are to be found, in several instances extending for thousands of miles.

Once in the interior other adverse conditions are encountered in the construction of both wagon and railroads. Deep snows with the attendant large and variable run-off, exceedingly rough country, permanently frozen ground covered with a thick mantle of moss, and great areas of swamp land, are some of the conditions most commonly met. Scarcity of good labor and high rate of pay also contribute to the difficulties and expense of the work.

Alaska is a territory of considerable size as is evident when it is compared with other districts with which we are more familiar; for instance it is twice the size of Texas and about one-fifth that of the total area of the United States. It is a new country, new geologically, as is shown by the great boulder and gravel strewn planes of the northern and central ports, and new in civilization and development as there are only 64,000 inhabitants, less than 36,000 being whites.

Alaska was purchased from Russia in 1867 for the sum of $7,200,000 since which time it has returned to the people of the United States over $460,000,000 or sixty-three times the purchase price. Of this sum $244,156,000 in gold has been taken from the gold-bearing gravel, while the remaining $215,844,000 is distributed among minerals, fishery products, furs, etc. The average annual commerce between Alaska and the States amounts to no mean sum, being very close to $50,000,000, and is made up of outgoing ores, canned fish, furs, etc., while incoming shipments of food stuffs, machinery, coal, and lumber amount to approximately $17,000,000 per year. Over 40,000 tons of freight are handled by steamboats operating on the Yukon alone. No reliable estimate of the freight carried over the military road to Fairbanks and on the Kuskokwim is available, but it must amount to several thousand tons. Practically none of this freight

is handled by any of the existing railroads, but is largely delivered from the boats at the point of consumption or use.

The question of railroads for Alaska is not a new one, as is evident from the fact that over forty-five roads have been proposed and constructed; however, of this number only ten have begun construction, although the stock of a number of others has been placed on the market.

The railroads that have been constructed, together with other data such as mileage, terminals, and gauge, are given in the following table: *

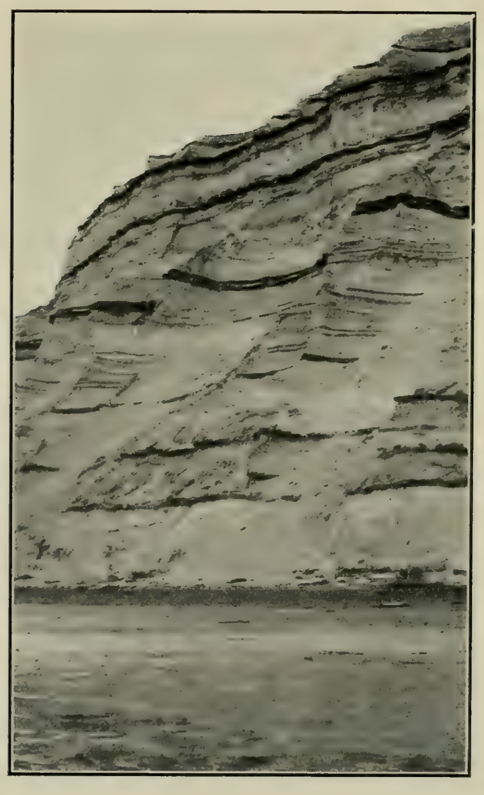
Southeastern Alaska:	
White Pass and Yukon route, Shagway to White Pass (narrow gauge). Terminal at White Horse, Yukon Territory—total mileage, 102 miles.........	20.4
Yakutat Southern Railway, Yakutat to Situk River (narrow gauge)	9.0
Copper River: Copper River & Northwestern Railway, Cordova to Kennicott (standard gauge)...........	195.0
Kenai Peninsula: Alaska Northern Railway, Seward to a point near head of Turnagain Arm (standard gauge)	71.6
Yukon Basin: Tanana Valley Railway, Fairbanks and Chena to Chatanika (narrow gauge)..............	46.0
Seward Peninsula:	
Seward Peninsula Railway, Nome to Shelton (narrow gauge)..................................	80.0
Paystreak, Branch, Seward Peninsula Railway (narrow gauge)	6.5
Council City & Solomon River Railway, Council to Penelope Creek (standard gauge).................	32.5
Wild Goose Railway, Council to Ophir Creek (narrow gauge)	5.0
	466.0

As previously pointed out the coastal terminals for railways in Alaska are comparatively few even after the broad mountain barrier which screens the greater part of the territory

* Railway Routes in Alaska, and Report of Alaska Railroad Commission. 62d Congress, 3d Session. Document No. 1346.

has been broken through. It may be said that under the above limiting conditions the coastal terminations of railways must come between Bristol Bay on the west and Lynn Canal on the east, although it has been placed between Cook Inlet and Lynn Canal, a much more limited distance.

Leaving out of consideration that part of Alaska which lies north of a line extending almost due eastward from the lower end of Kotzebue Sound to the international boundary line, as being unprepared for railway transportation, and dividing the remaining territory by a line extending almost due south from a point on the Yukon near Tanana to the west coast of Cook Inlet, we have the two large districts into which railways must be built. Of these two districts, the one lying to the east



Coal Resources of Cook Inlet—Outcrops of Coal Beds on Bluffs.

has an area of 125,000 square miles and constitutes what is known as central Alaska. It has produced in gold alone over $75,000,000 while over $5,000,000 worth of copper is annually shipped to the States. Further, it contains the great known coal fields of the Territory. A third district includes the whole of southeastern Alaska or the so-called Pan-handle, which contains some of the largest gold mines in the world, having an annual production in gold of $4,000,000. Practically all of the transportation lines so far planned for the territory have been located within these areas. * The district lying to the westward is less well known, but gives promise of being a good mineral producer.

According to Alfred H. Brooks, ** Member of the Recent Railway Commission, the geographic features limit the routes to four zones which are as follows: (1) the Chilkat basin, (2) the Alsek basin, (3) the Copper basin, and (4) the Susitna basin. The rivers after which the basins are named indicate the general position and direction of the routes.

The three districts first outlined above may be designated as follows: (1) A, the western; B, the middle; and C, the eastern. The railways that have been proposed and constructed or partially constructed in each of these districts are given below:

District A.

Chilkat Inlet Ry. and Navigation Co.
Alaska and Northwestern Ry. Co.
Chilkat and Yukon Ry. Co.
Haines Mission and Boundary R. R. Co.
Dyea and Chilkoot R. R. Co.
Chilkoot R. R. and Transportation Co.
Chilkoot Pass Transportation Co.
*Pacific and Artic Ry. and Navigation Co.
American and Canadian Transportation Co.
Yukon Railway Company.
Yukon Mining, Trading and Transportation Co.

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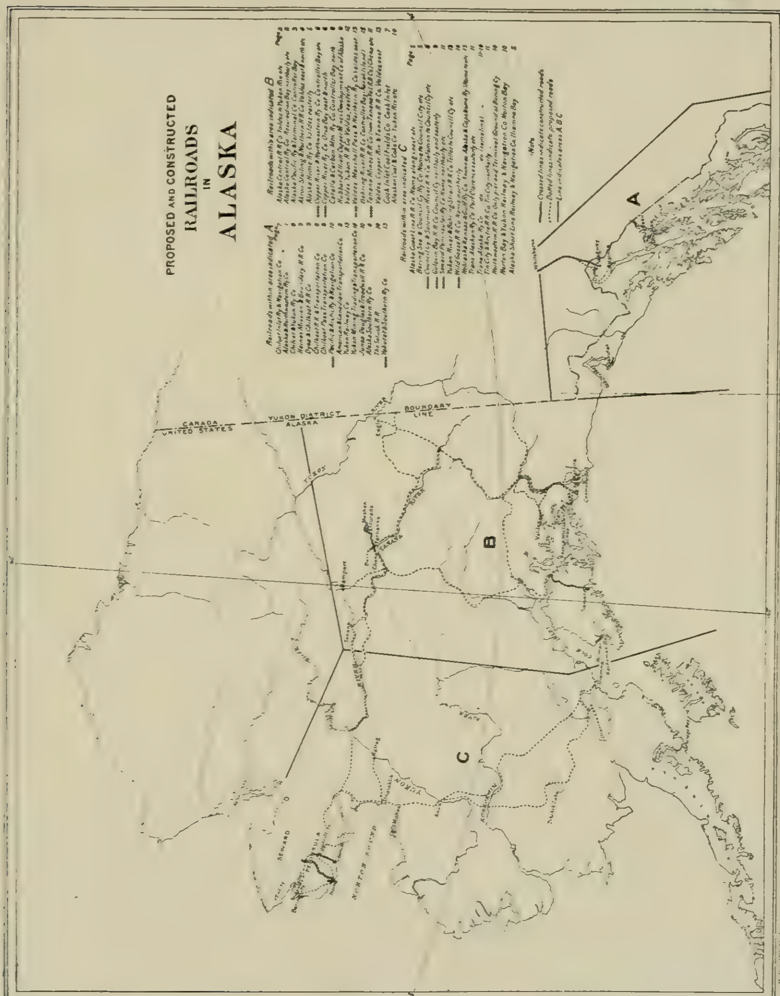
* Railroads in Alaska. 60th Congress, 2d Session. Document No. 1201. See accompanying map.

** The U. S. G. S., Bulletin No. 284, page 11.

Juneau, Douglas and Treadwell R. R. Co.
Aslaska Southern Ry. Co.
The Setuck R. R. Co.
*The Yakutat and Southern Ry. Co.



District B.

Alaska Central R. R. Co. Valdez to Yukon River, etc.
Alaska Central Ry Co. Resurrection Bay northerly, etc.
Alaska Pacific Ry. and Terminal Co., Controller Bay.

Akron, Sterling and Northern R. R. Co., Valdez east and north.

Alaska Home Ry. Co., Valdez easterly.

*Copper River and Northwestern Ry. Co., Controller Bay, etc.

*Copper River Ry. Co., Orca Bay east and north.

Katalla and Carbon Mtn. Ry. Co., Controller Bay north.

Hubbard-Elliott Copper Mines Development Co. of Alaska.

Valdez-Yukon R. R. Co., Valdez easterly.

*Valdez-Marshall Pass and Northern Ry. Co., Valdez east.

Bering River R. R. Co., Controller Bay (Kanak Island).

*Tanana Mines R. R. Co. (Now Tanana Valdez R. R. Co.)

Valdez, Copper River and Tanana R. R. Co., Valdez east.

Cook Inlet Coal Fields Co., Cook Inlet.

Alaskan Coal and Coke Co., Yukon River.

District C.

Alaska Coast Line R. R. Co., Nome along coast.

Bering Sea and Council City Ry. Co., Nome to Council City, etc.

*Council City and Solomon River R. R. Co., Solomon to Council City, etc.

*Golovin Bay R. R. Co., Council City northerly and easterly.

*Seward Peninsula Ry. Co., Nome northerly, etc.

Yukon River and Bering Strait R. R. Co., Teller to Council City, etc.

*Wild Goose R. R. Co., Nome northerly.

Nebraska, Kansas and Gulf Ry. Co. (known as Alaska and Cape Nome Ry.)

Trans-Alaskan Ry. Co., Port Clarence easterly, etc.

Trans-Alaska Ry. Co., Port Clarence easterly, etc.

Tin City and Arctic R. R. Co., Tin City northerly.

Northwestern R. R. Co., Only pier and terminal ground at Bering City.

Norton Bay and Yukon Railway and Navigation Co., Norton Bay.

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(1): Railroads in Alaska. 60th Congress, 2d Session. Document No. 1201.

* Constructed roads.

Alaska Short Line Railway and Navigation Co., Iliamna Bay.

That it has not proven to be an easy task to finance railways in Alaska is evident from the fact that out of the forty-five that have been incorporated only nine have had sufficient construction work done to permit them to be called railways, while in a number of instances the point has been stretched to allow of this, as less than ten miles of rails have been laid.

It is not likely that other railways will be built in Alaska by private capital, at least for some time to come. The question might be asked, why is there such a reluctance on the part of private corporations to build railways in this territory? It is surely not because railways in Alaska would offer less in the way of return to investments than do railways in other new countries, but rather that conditions have changed. The transcontinental railways of the states were given material assistance through large subsidies of land. Few people today, and particularly those living in the west, look with favor upon such a method of encouraging the construction of railways. There is little doubt but that capital could readily be secured for Alaskan railways should the government offer sufficiently alluring opportunities to participate in the natural resources, as has been done in the states in the past.

The people of the United States have now come to the point where they demand that a corporation must be what it claims to be in order that competition may be free and fair, and by the same token a railroad must be a common carrier and not a producer of freight. It is claimed that such a railroad would not pay immediately in Alaska, and the contention is doubtless true.

What, then, is the solution of the problem? The answer is, government constructed and owned railways. But the territory of Alaska is large and its resources diversified; as new resources are discovered new districts will be opened up and railways will go to them. Development well under way, private capital will not be slow to fall in line and do its part.

Mr. Lane, Secretary of the Department of the Interior, has given several reasons why the government should undertake railroad building in Alaska; he says:

"I have already expressed my belief that it was wise for the government itself to undertake the construction and operation of a system of trunk line railroads in Alaska. And I am led to this view irrespective of the possibility of private enterprise undertaking such work, although my belief is that no railroads would be privately constructed in Alaska for many years to come excepting adjuncts to some private enterprise. Be that as it may, it would seem wise for the government to undertake this task upon grounds of state. The rates and the service of such railroads should be fixed with reference to Alaskan development—not with regard to immediate returns. The charges fixed should be lower for years to come than would justify private investment. I would build and operate the highways in the same spirit that the counties or the states build wagon roads—not for revenue, but for the general good. After all, a railroad is little more than an operated wagon road. In many countries they still call railroad cars "wagons." Our laws as to railroads are evolved from our old laws as to carriage by wagon. Our courts speak of railroads as property charged with a public interest and so justify the regulation of their rates. But no court would justify the imposition of rates made for the purpose for which Alaskan rates should be made—the creation of a commonwealth. If this is our task, it should be done * * * with a consciousness that the dollar spent today on an Alaskan railroad will yield no more immediate return on the investment than the dollar spent on the Panama Canal.

These, then, are persuading reasons for the belief that the government should undertake to drive from the coast inland one or more lines of railroad: (1) The government already regards it as its duty to build wagon roads. Such roads when well built are almost as costly as the construction of a railroad, which is the essential modern means of transportation. (2) There can be no assurance that without surrendering our resources in Alaska private railroads will be built. (3) The opening of this new country demands that the highways of travel and commerce should be made wholly subservient, not to private interests, but to the upbuilding of this territory, that they may be the real servants of the national purpose.

If it is thought wise to recoup the government for its original outlay it can be done, at least in part, by following a

plan not unknown to our people—by giving a land subsidy to the owners of the road. Retain in the government one-half of the land on each side of the railroad until it had appreciated in value by the growth of the lands given to the public. Thus the government would subsidize itself and reap some of the benefits accruing to its land from the construction of the road. Judging by the increase in land values in the newly opened sections of Canada, who could say but that long before the bonds were due the government would thus have an asset sufficient to meet the original debt?"

On October 20, 1914, the President signed the Alaskan railway bill, which directed him to purchase or construct 500 miles of railroad in Alaska at a cost not to exceed $35,000,000. The bill places upon the president responsibility for the selection of the route from tidewater to the interior and the construction, equipment, and operation or leasing of such lines as he may construct or buy to constitute this route.

The bill further provides for a redemption fund into which shall be paid 50 per cent of all moneys derived from the sale of public lands in Alaska or of the coal or mineral contents thereof. Machinery utilized in the construction of the Panama Canal is made available for the construction work.

On April 10, 1915, President Wilson announced the route of the new Alaskan railroad, which is to be known as the Susitna route. The termini of the line are Seward on Resurrection Bay and Fairbanks on the Tanana River, a distance of 471 miles.

In order that a comprehensive idea may be had of transportation methods in Alaska brief statements will be made which will cover the ground in a general way, special emphasis being placed upon ocean, river, and railroad transportation.

Ocean Transportation.

Few of the seaports of Alaska are connected by roads of any description whatever, which means that they are more or less isolated and must depend upon boat service almost entirely. The harbors of southeastern Alaska, and extending to Cook Inlet in the Gulf of Alaska, are within 1500 miles of Puget Sound ports, being practically free from ice the year round. Six trips a month are maintained during the summer to the more extreme points, while the ports of southeastern Alaska have more fre-

quent service. Winter service is maintained, but at less frequent intervals. Nome and St. Michaels are accessible during about three months of the year, steamers making trips direct from Puget Sound points. There is no regular and continuous service between Alaskan ports except those east of Cook Inlet.

The following steamship lines operate between Alaska and the States: *

1. Alaska Steamship Company	13 boats
2. Pacific Coast Steamship Company	6 "
3. Alaska Coast Steamship Company	3 "
4. Western Alaska Steamship Company	3 "
5. Northern Steamship Company	2 "
6. Humboldt Steamship Company	1 boat
7. Dodge Steamship Company	1 "
8. Canadian-Pacific Navigation Company	2 boats
9. Various smaller lines, cannery vessels, and small independent boats	
Total	31 boats

The net burden of the boats operated by the above companies ranges from 500 to 2400 tons. The service from Puget Sound ports is approximately as follows: to Skagway, one passenger and one freight vessel every two days in summer and every three days in winter; to Seward, six passenger and two freight boats per month, and four passenger and two freight boats in winter. Cook Inlet points are served about once in every twenty-three to twenty-five days. Nome and Bering Sea ports have six combination passenger and freight boats, and from four to six freight boats call during the four months extending from June 1 to October 1.

Seward on Resurrection Bay will probably become the most important northern sea port as it will be the coastal terminus of the new government railroad now being built. However, the new town of Anchorage on Knik Arm, which has sprung into life during the last year, will probably be a more important commercial center for some time to come, as the construction of the railroad will be extended both to the north and south and

* Transportation Conditions in Alaska, by Captain James Gordon Steese. The American Review of Reviews, 1914.

Seward on Resurrection Bay—The Southern Terminus of the Government Railway.

all of the supplies will have to be handled there. Anchorage is situated on the south side of Knik Arm near the mouth of Woodrow Creek, formerly called Ship Creek. The harbor at Woodrow Creek has been used for years by ocean-going boats as it is the only deep-water anchorage in the Arm; formerly all supplies for Susitna and Knik were lightered from this point.

Juneau and Skagway will probably not be affected much by the construction or operation of the government railroad as they already occupy important industrial and commercial positions; the former being the capitol of the Territory of Alaska besides being situated in close proximity to several large and rich gold mines, namely, the Alaska Treadwell and The Alaska Gold Mines Company; Skagway is the coastal terminus of the White Pass and Yukon railroad which connects the coast with the valley of the Yukon River. These towns as well as other sea ports of southeastern Alaska, while not affected directly by the railroad, will undoubtedly benefit by the increased business that will attend the construction and operation of the railway.

Ocean transportation in Alaskan waters has proven very costly for the companies operating the steamships, owing to the exceedingly rough coast and very inadequate protection of light-

houses and other aids to navigation. The invidious comparison, that is almost unconsciously made by those passing through Canadian and United States territory respectively, is far from complimentary to the policy of the government in encouraging the development and growth of Alaska. Hardly a year passes but that some vessel engaged in Alaska coast-wise trade is wrecked with almost invariable loss of life. To complete the system and ensure the proper and efficient operation of the scheme of transportation inaugurated by the construction of the government railroad, a line of government owned steamships should operate between the states and Alaska. Anything short of this or a confiscatory policy will mean that the full benefit of the enlarged and improved transportation facilities provided by the railroad will not be realized.

Railroad Transportation.

Of the nine railways that have been constructed and put in operation in the Territory of Alaska three will be discussed and a fourth cited as typical of the work of pioneer railroad building. In fact each of the three routes first discussed has been pushed through the great mountain barrier which extends for over 1,000 miles along the coast and represents undoubtedly the most formidable obstacle to railroad construction. The three lines that have been chosen are the White Pass and Yukon route, the Copper River and Northwestern, and the Alaska Northern Railway. The fourth is the Alaska Short-Line route.

The White Pass and Yukon Railway follows one of the routes taken by prospectors in 1897 when the rush to the gold fields began. Fully 28,000 people went over the White and Chilkoot passes during 1898, carrying upward of 35,000 tons of freight, which were transported by horse, sleds and on the backs of men. The White Pass is less steep than Chilkoot but somewhat longer; it has an elevation of 2,880 feet and is very rugged. The distance from tidewater to navigable waters tributary to the Yukon by way of the White Pass is 110 miles. The first twenty miles, in United States territory, has the maximum grade, which is a trifle less than 4 per cent for about fifteen miles. The international boundary line is crossed at the summit, so that ninety miles are in Canadian territory. The road was built by W. J.

Heney, contractor, who did the work in record time and overcame many and trying obstacles.

While this railroad can hardly be considered as an American line, yet it will exert considerable influence as a competitor to any other line or lines that may be built connecting the coast with the interior, as it has been for some time a well established route for passengers and freight to the Yukon basin.

The Copper River and Northwestern railroad extends from Cordova, a town situated on an arm of Prince Williams Sound, to the mouth of the Copper River, thence up the river to Chitna, then along the Chitna River to Kennicott. At Kennicott is the Bonanza copper mine, probably one of the richest in the world, which is owned by the combined Morgan-Guggenheim interests.

Few railroads have ever been built and put in successful operation in so short a time and under such adverse conditions as was this road. In the first place several false starts were made before the present route was decided upon, which was practically chosen by a process of elimination; Valdez was first selected for the coastal terminus but was abandoned owing to excessive grade—at least that is the claim—then Katalla was chosen, but after spending about a million dollars it too was abandoned through failure to secure a suitable harbor. Finally Cordova was definitely decided upon and the line was rapidly pushed out along the coast and up the river.

Copper River and Northwestern Railroad.

To traverse the low country adjacent to the coast was not difficult, but serious trouble was encountered when the delta of the Copper River was reached. The Copper River, like most of the Alaskan rivers, is fed by glaciers. It therefore transports large quantities of silt which is readily carried in the upper reaches of the river but which on approaching the sea level is deposited, forming great areas of mudflats through which many sluggish streams run. Further, periodic floods, which are characteristic of such streams, inundate the delta, entirely changing the appearance of the country, especially with respect to land and water.

In spite of these difficulties the road was energetically pushed forward, trestle-work, fills, and bridges following one another in rapid succession until the gorge of the river was reached, when a new obstacle presented itself, namely, the passage of the glacial region. Some forty-nine miles from the mouth of the river, Childs glacier is met which presents a wall of ice ranging from 150 to 300 feet in height and extending for three miles along the north bank of the river, in fact forming the bank of the river itself. To pass this glacier it was necessary to cross the river, then as Miles glacier occurs on that side and but a short distance beyond it was necessary to recross the river. Miles glacier also reaches to the river but as it is retreating the danger from ice is less than with the Childs glacier. Following the bank of the river opposite the Miles glacier the railroad extends for seven miles through the rough country of Abercrombie Canon, when still another glacier is encountered, namely, the Allen glacier. This glacier, like the Miles, has retreated, but to a much greater extent; in fact it is practically a dead glacier, i. e., has ceased to advance. The roadbed was built for miles upon the terminal moraine of this glacier and in places was actually laid on stagnant ice. Beyond this point, troubles from glacial ice were past, but an exceedingly rough country had to be traversed.

Work on the road was carried on throughout the year; winter work except for the extreme cold had its advantages in that much of the construction work could be done upon the ice which covered the river. It is said that one of the steel bridges that was built over the river at a cost of $1,500,000 had been completed but a few hours when the ice of the river broke up,

The Million-and-a-half-dollar Bridge Built Across the Copper River Near Childs Glacier.

and the supporting substructure was swept away. The road is 195 miles long and has a maximum grade not exceeding 9/10 per cent, while the curvature does not exceed 14 degrees.

Maintenance of this road is high owing to frequent washouts in the spring and summer, and snowslides during the winter months. The traffic upon the road is limited almost entirely to the shipment of copper ore from the Bonanza mines, which in turn is transshipped at Cordova for treatment in smelters in the States. In order that the weight may be reduced to a considerable extent the ore is put through a concentrating mill situated at the mines.

It was the Cordova-Chitna portion of this railroad that the Railroad Commission recommended that the government buy or lease as the initial part of the route to Fairbanks. While this was not done there is little doubt but that at some time in the future the road will be continued up the valley of the Copper River to Fairbanks or the Yukon, or to both.

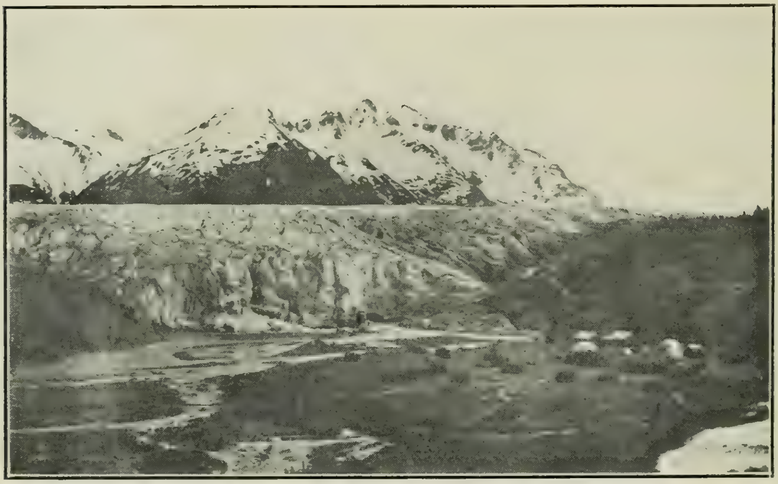
The Alaska Northern Railway, formerly the Alaska Central Railway, was projected from Seward on Resurrection Bay to Fairbanks by way of the Susitna Valley and Broad Pass. It has been chosen as the route of the new government railroad, and

the portion that was built has been purchased and will be merged with the government constructed portion to complete the line.

A terminal dock suitable for loading ocean-going vessels was constructed at Seward upon which cars may be run, connection being made by means of a trestle. The railroad yards are within a half-mile of the dock.

Seward is built upon a gravel flat formed by glaciers that formerly extended into the bay from the high mountains on the west. From the town the railroad passes up a broad timbered valley at a moderate grade to the first summit at mile Twelve, which is 600 feet above sea-level. At mile Forty-five a second summit has to be crossed which has an elevation of 1060 feet, beyond which the valley of Placer River is followed to Turnagain Arm, an extension of Cook Inlet.

Along this route as on the Copper River railroad there are a number of glaciers much smaller, however, than those mentioned there. Glaciers are bad neighbors to railroads, not only from the danger of rapid advance and shifting course of the swiftly flowing streams, but from the sudden outburst of great quantities of water that have been impounded in the glacier.



Camp 54 Alaska Northern Railway.

There is little or no danger of damage to the railroad along this route due to advancing glaciers but much trouble has been

experienced from the shifting glacial streams—the valley of Placer River is particularly troublesome for this reason.

On the descent into the valley of Placer River there are two miles of track built on two reverse horseshoe curves and one complete loop. One of the curves is on a four-deck trestle which has a length of 1,350 feet and of the three remaining trestles the highest has a 14-degree curve with a grade of 2.2 per cent. * This grade is the steepest to be found on the 71 miles of the constructed line.

Tunnel on Line of the Alaska Northern R. R.

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* Railway Routes in Alaska, Report of Alaska Railroad Commission. 62nd Congress, 3d Session. Document No. 1346, page 80.

Seven tunnels have been driven, several of them in close proximity. The last six occur within a distance of 4,500 feet and have an aggregate length of 3,000 feet. The tunnels constitute one of the most disadvantageous features of the road as the large quantities of water encountered freeze in winter making it extremely difficult to keep the tunnels open. It is possible to overcome this trouble by choosing a slightly different route, but so far as I am aware the government engineers have not indicated their intentions.

On reaching Turnagain Arm the road as constructed follows the east shore to Kern Creek, which is as far as the road is built. From Kern Creek to the south shore of Knik Arm, an eastern extension of Cook Inlet, the track is exposed to snowslides and will have to be protected by snowsheds.

As the line swings to the east, following the south shore of Knik Arm, it will pass through the new town of Anchorage, previously mentioned as being situated at the last deep-water harbor for these waters. At Anchorage the government has constructed docks for loading and unloading freight, and coal brought down from the Matanuska coal fields. As the highest tides here will probably reach a height of 45 or 50 feet and the movement of the water is correspondingly swift, large concrete piers or platforms have been built upon which barges will

View up the Matanuska River.

be placed to permit of their being loaded independent of the tides. This method of procedure obviates the construction of floating docks, which would have to be connected by means of some flexible medium with a stationary shore construction.

From Anchorage the road will run about 25 miles to the east when the head of Knik Arm will be reached and crossed. On the north shore of the Arm a branch line will be built to the coal fields on the Matanuska River; the point where the Matanuska line leaves the main line will be known as Matanuska Junction. From the Junction the road will proceed northwestward to the valley of the Susitna River; it will then turn to the north, following the Susitna to a point south of Broad Pass when it will cross the Susitna and enter Broad Pass. From Broad Pass the line will extend to Fairbanks in a northeasterly direction and at a moderate grade.

Coal Camp on Chickaloon Creek—Probable Terminal of Railway up the Matanuska River.

It is claimed that the grade of the road between Seward and the Matanuska coal fields will be low, 2.2 per cent, while for the whole line it will be probably nearer 2 per cent.

In order to reduce the expense of maintenance and also permit much heavier loads to be hauled it has been proposed to put a line through Moose Pass. This route has a maximum elevation of 1330 feet, somewhat higher than the second sum-

mit, but owing to the fact that less rock work would be required and there would be no danger of rock and snow slides, it is considered much more desirable than the present one. Further, the approach to the pass on both sides is fairly gradual, but the chief disadvantage is that after the divide has been passed Turnagain Arm would have to be crossed on a trestle or gone around by a long detour, which might overbalance the advantage of construction through Moose Pass.

The three routes mentioned above have been both constructed and operated and are therefore a reality. There is, however, another proposed line which is interesting from the standpoint of location and the importance of the country that it would serve, namely, the Alaska Short-Line Railway and Navigation Company's proposed line. This route would have as its coastal terminus Iliamna Bay, from which point it would traverse the upper end of the Alaskan Peninsula and proceed in a northwesterly direction across the Kuskokwim River to Anvik on the Yukon and thence to Nome on Seward Peninsula. It is claimed that the grade for this road would be considerably less than for any of the other routes proposed or built. Probably the most difficult part of the lines to construct would be the first ten miles across the mountain barrier, but by the construction of a tunnel 1600 feet long the summit could be passed at an elevation of about 750 feet, beyond which point the country affords no obstacle more difficult than is found in ordinary railroad construction.

Naturally the question as to whether a railroad built in a new country will or will not pay must be considered largely from the standpoint of freight rather than passenger traffic, but the latter must not be ignored as it is very likely to prove a not inconsiderable item in the maintenance of such lines. The permanent population will grow with the coming of transportation facilities, while the transient population and number of tourists will increase with the knowledge of the country and its attractions as a summer resort. The scenery along all of the routes mentioned equals, if it does not surpass, that to be found in Switzerland and other well known parts of Europe.

The railroads that have been described have as their coastal terminals most excellent harbors, which not only have deep water and ample room but could readily be fortified and mined.

This is particularly true of Resurrection Bay, the terminus of the new Government line.

River Transportation.

In a country as well supplied as Alaska is with large navigable rivers, transportation by boats on such water-ways must of necessity play an important role in the commerce of the country. In fact up to the present time river transportation has been the principal means of distributing the freight delivered to the coastal towns, and will always be an important factor and a keen competitor to railroads. With the river ports connected with railways the last link in the system of steam transportation will have been effected. Then freight shipments from the States may be moved continuously and rapidly by ocean and river boats and railroads to its point of destination in the interior.

The unifying of these various systems of transportation has not been encouraged in the United States, but the building of railroads in Alaska may require the experiment of having water transportation merged with rail in order to ensure the success of the former. The whole system of transportation will in fact be viewed as an experiment by the people of the States, and will therefore be watched with considerable interest. In passing it might be mentioned that such unifying of river and rail transportation has been tried with conspicuous success in several countries. The most important and striking example is that of Germany.

There are several large rivers in Alaska now serving a most useful purpose in the development of the Territory, the most important being the Yukon, Porcupine, Tanana, Koyukuk, Innoko, Iditorod, and Kuskokwim, which aggregate about 5000 miles of navigable waterways. The Yukon is navigable for fully 2000 miles; the next in importance is the Kuskokwim, navigable for at least 1000 miles; and the Tanana, which although considerably shorter passes through a fairly well proven territory from the standpoint of natural resources.

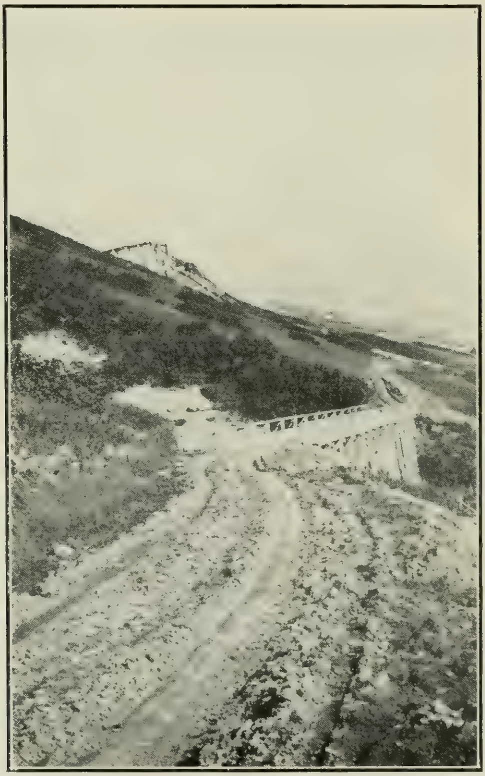
Connect these waterways with railways serving mining and agricultural districts and the rapid development of the territory will be assured.

The following table gives the lines operating on the Alaskan inland waters:

Northern Navigation Company	20	boats
White Pass and Yukon Route	16	"
Merchants Yukon Line	4	"
Cook's Inlet Transportation Company	1	"
Goergie Steamship Company	1	"

Wagon and Sled Roads and Trails.

As there is a marked difference in the charting and safeguarding of the coastal waters of the Pacific coast line in territory owned by Canada and the United States so there is an equally marked difference in methods of constructing roads in



Wagon Rcad to Coal Mine Near Chigink Bay, Alaska.

Alaska proper and the Yukon Territory. We often wonder why there are more people in British Alaska than in our territory of Alaska. To some it is simply a matter of roads which facilitate business by facilitating travel. While that may be only a partial reason yet it is a potent one, and until we also feel the need of adopting means looking toward permanent development, we must not complain should others attain the object sought before we do. To those who view our efforts from a distance it would seem that we are simply reaching out for purposes of exploitation and profit. But until the ignorance of our law-makers with respect to the true conditions of Alaska is dissipated, the people of Alaska will have to be content with an exceedingly slow and very inadequate development.

Work on Alaskan roads and trails was begun by the government in 1898. Two years later an appropriation of $100,000 was made for carrying on the work, but it was not until 1905 that the Board of Road Commissioners of Alaska was appointed. Col. W. P. Richardson, U. S. A., who has been president of the Board since its organization, with two other members of the Board have done very efficient work in providing an important means of travel and transportation for those living and doing business in the Territory.

Of the 3,600 miles of route constructed in the Territory, 872 miles are designated as road, 582 miles as sled road, and 2,209 miles as trail. In order of importance the Valdez-Fairbanks road stands first, while shorter roads connect less important places such as Nome, Circle, Ruby, Eagle, Haines, and Juneau with rivers or coast. Sled roads and trails traverse the country in practically every direction, some of which are impassable in summer, others in winter. The wagon roads and trails in Alaska have been built by money obtained from Congress largely through subterfuge, the statement being made that they were needed for military purposes.

The Alaskan Road Commission has adopted the following classification for road work: * * Wagon roads are any roads cleared, grubbed, ditched, and graded and drained sufficiently

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* * Transportation Conditions in Alaska, by Capt. J. G. Steese. The American Review of Reviews, 1914.

to accommodate wagon traffic; sled roads are cleared and graded but not grubbed.

Fairbanks is connected with Fort Gibbon and Circle by sled roads, while Fort Gibbon, Koyukuk, St. Michaels, Nome and Kotzebue Sound may be reached by trail. A trail also extends from Nome to Seward by way of the Kuskokwim and Susitna valleys, also from Iliamna Bay through the Mulchatna and Kuskokwim valleys.

In the location of roads the first consideration is good bottom, the next grade, and the last shortness of line. In some sections practically every condition adverse to road building is encountered, when all considerations must be sacrificed in order to make a passable thoroughfare. Frozen ground protected

Corduroy Road Along the Matanuska Trail.

by moss may require several seasons to be put in shape, the usual method of procedure being to clear the roadway during the first season and grade to frost line; the second season usually permits of completing the grading as the ground has thawed out. If the character of the ground underlying the moss is suited to form into a road surface, the moss is removed from the line of the drainage ditches only, the surface of the road being formed by corduroy upon which is thrown material taken from the ditches.

Sled roads are of course intended for winter use entirely, although an occasional "drag" road is made for hauling ore down a mountain during the summer. Much care must be taken to avoid drifts and places where ice tends to collect. The difficulty of crossing streams and lakes is eliminated as they are frozen over. The grade is the first and only consideration in the construction of sled roads, and long detours are often made to secure a proper grade.

Trails are for use throughout the year, although there are summer and winter trails; the former are for packhorse and foot travel during the summer, while the latter are for any form of travel that is possible during the winter months. Trails are usually cleared for a width of six to eight feet and are occasionally graded, the gulleys and creeks being bridged over. Winter

Bridge Over Kings Creek on the Matanuska Trail.

trails are marked with sticks and tripods placed at intervals of about 150 feet.

Cost of Road-Building and Transportation.

The cost of construction of transportation routes in Alaska, like all other work, is very high, due to lack of transportation facilities. The cost of the pioneer roads will be considerably greater than for other roads that follow, as labor and conditions affecting the construction of the roads will improve to some extent. Further, the forming of the road-bed through moss and frozen ground will improve with experience; the choice of suitable timber for erecting trestles will have to be solved; * as will protection of the road-bed and trestles from the destructive effect of the swift and ever-shifting glacial streams; the water problem, which is in a way exceptional; methods of properly safeguarding the roads from earth and snow slides; and many other minor conditions that cannot be mentioned here.

In order that an idea may be had of the cost of railroad construction in Alaska, the following figures are given, but are undoubtedly high and should not be considered as probable costs of such work in the future and under more auspicious conditions:

The White Pass & Yukon Railway........	$62,000	per mile
The Copper River and Northwestern R. R..	75,000	" "
The Alaska Central Railway.............	71,000	" "

Cost of wagon and sled roads and trails has been given as follows: **

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* The Forestry Service has granted a permit to the Alaskan Engineering Commission to cut 85,000,000 feet of timber in the Chugach forest reserve for use in constructing the new government railroad. The timber will be cut along the right-of-way of the railroad. Tests are being made on the spruce and hemlock in the Forest Service laboratory at Seattle and from the results already obtained it will probably be sufficiently strong for the use to which it will be put. Mining and Scientific Press, August 21, 1915, page 294.

** Glen E. Edgerton in the Engineering Record, abstracted in the Engineering Magazine, August, 1915.

Cheap transportation on land which is anticipated by operation of the new railroad will not mean much to Alaska unless the cost of transportation by boat can be materially reduced. That this can be effected is confidently expected. The approximate freight and passenger rates from Seattle to the southern central Alaskan towns are as follows: *

Point of Destination	Coal per ton	Gen'l Mdse per ton	Lumber Per M. Rough	Lumber Per M. Dressed	Mchy. per ton.	Forage per ton Hay	Forage per ton Grain	Horses per head.	Passenger Rates First Class	Passenger Rates Second Class
Ketchikan	$ 5	$ 8	$ 7.50-11.25	$ 6.50	$ 8-22	$15	$ 9	$ 20	$ 22	$ 14
Juneau	5	9	7.50-11.25	6.50	9-23	15	9	20	25	16
Katalla	6	11	15.00-18.00	10-13.00	11-24	15	11	25-30	45	25
Cordova	6	11	15.00-18.00	10-13.00	11-24	15	11	25-30	45	25
Valdez	6	11	15.00-18.00	10-13.00	11-24	15	11	25-30	45	25
Seward	6	11	15.00-18.00	10-13.00	11-24	15	11	25-30	45	25
Kodiak	8	14	18.00-21.00	13-16.00	14-27	18	13	25-30	55	38
Knik	10	15	20.00-23.00	16-17.00	15-28	19	16	25-30	55	38
Unga	10	17	20.00-23.00	15-19.00	16-30	21	17	25-30	70	47

* U. S. G. S., Bull. 442, page 24. While some of the items may have been changed since these were collected yet in the main they are correct. Freight on coal to Seward is now $6.25 per ton plus a 10 cent Territorial tax.

Wagon roads per mile..................	$ 2,484
Sled roads per mile....................	229
Trails per mile........................	98

The Alaskan Road Commission has had considerable experience in the construction of roads under practically all of the conditions that are known to exist in the territory so that the above figures, while exceeding their estimate* by a few dollars are approximately accurate. It is claimed that it will cost $7,-250,000 to complete the wagon road system planned for Alaska, which sum will have to be secured from Congress with the exception of about $1,000,000 that will be available from territorial taxes.

Maintenance of all forms of roads is such a variable quantity that at this stage of the work it is not worth while to consider it; however, maintenance costs on railroad work must be very high judging from the difficulties experienced by the existing roads from floods and earth and snow slides. The Alaska Northern Railway was not able to operate more than four months during the year owing to excessive snow fall on the summits; ten to twelve feet of snow are common and some seasons there is much more. Glaciers formed by the freezing of large quantities of water working its way down the mountains from the snow and ice above effectively closed the tunnels and rendered other portions of the line exceedingly dangerous. On the Copper River road, floods on the delta of the river often stopped traffic for days at a time, while snow slides occasionally tied up the road for days and weeks.

Maintenance for wagon and sled roads is given by the Road Commission as $225 and $25 per mile annually, while the amount expended on trails is $10 per mile.* No small part of this maintenance cost is due to the cutting out of wind falls, which owing to the narrowness of the cleared way are of frequent occurrence.

In conclusion I will repeat that transportation, be it by rail or wagon road, is absolutely imperative for the development of Alaska, but with the coming of adequate transportation facilities the great undeveloped resources of the Territory will soon

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* Transportation Conditions in Alaska. Capt. J. G. Steese. The American Review of Reviews, 1914.

become known and Alaska instead of being a burden to the people of the United States will prove to be one of the richest portions of our domain. Development, once begun, will be sure and rapid, which will attract both people and capital and will thus build up a permanent population and give permanency to investment.

PRESIDENT: Gentlemen, the subject is now open for general discussion. If any one wishes to ask any questions, Dr. Crane will be glad to answer them.

MR. A. E. ANDERSON: I would like to ask the actual situation as to excavation in that territory, as compared with excavation in the United States, as affected by weather conditions at different times of the year, frost, snow, etc.

DR. CRANE: Excavation for railway construction in Alaska will of necessity be confined to the summer months, probably from May 1 to October 1, due of course to heavy snow-fall and accumulations of ice. There is little or no soil, except in isolated places, but much gravel and many boulders. There will be much rock excavation required and no little tunnel driving. The two localities where such work will of necessity be very extensive are the Placer River valley and that part of the route paralleling the Susitna River.

MR. ANDERSON: What is the nature of the rock?

DR. CRANE: There is a great range in kind and quantity of formations that will be encountered, namely: granite, slate, schist, limestone, sandstone, igneous intrusions, etc. A very detailed reconnoisance will have to be made before definite information can be secured upon which estimation of amount and cost of excavation can be made.

MR. JOS. PAINTER: What is the character and extent of the timber?

DR. CRANE: Spruce and hemlock are plentiful, but the quality is poor. However, the National Forestry department is investigating the timber in order to determine its adaptability to railroad construction work. It has been used to a limited extent in the past and will undoubtedly be used in preference to shipping in timber from British Columbia and the States.

MR. PAINTER: Why do the people of Alaska object to the leasing bill?

DR. CRANE: Because they have paid for the land for which they have made application for patent, and have acted in good faith; they now want the right to mine the coal on their own property—it is that or nothing.

MR. ANDERSON: What is the quality of the coal?

DR. CRANE: The quality of the coal is excellent and judged from the standpoint of chemical analysis and heating effect it is equal to any coal in the United States.

MR. PAINTER: What is the gauge of the Alaska Northern railway?

DR. CRANE: Standard gauge, as are practically all of the railroads constructed in Alaska.

MR. F. H. STARK: This has been a most interesting subject and I am sure we could spend an hour longer in listening to the discussion of this wonderful country. But time is passing and it is growing late. I would therefore move that we extend a vote of thanks to Dr. Crane in appreciation of his very interesting paper.

The motion was carried by unanimous vote.

PRESIDENT: Is the Nominating Committee ready to report?

MR. D. M. HOWE: With your permission the Committee would submit the following report as their selection of nominees for the various offices for the ensuing year:

Your Nominating Committee appointed to nominate Officers to fill the various offices of the Club for the ensuing year beginning November 1st, 1915, beg leave to submit the following:

President—F. M. McNulty.

First Vice-President—J. G. Code.

Second Vice-President—H. H. Maxfield.

Treasurer—F. H. Stark.

Secretary—J. B. Anderson.

Executive Committee, (Four to elect)—L. H. Turner, D. J. Redding, F. R. McFeatters, A. G. Mitchell.

Finance Committee, (Five to elect)—D. C. Noble, E. K. Conneely, C. E. Postlethwaite, L. C. Bihler, W. V. Turner.

Membership Committee, (Seven to elect)—D. M. Howe, Chas. A. Lindstrom, A. Stucki, C. O. Dambach, Frank J. Lanahan, Harry Howe, R. L. Kleine.

Entertainment Committee, (Three to elect) — Stephen C. Mason, R. H. Blackall, D. H. Amsbary.

Signed { D. M. HOWE, Chairman
W. L. HOLBROOK,
H. G. SCHECK.
Committee.

ON MOTION, the Report of the Committee was accepted.

PRESIDENT: Under the Constitution the vote for officers will be taken by letter ballot. This ballot will be mailed you by the Secretary. If for any reason the Committee has named any one who is not entirely satisfactory to you, or if there is any one whom you would prefer to vote for to fill an office, you are entirely at liberty to insert any name you choose.

If there is no further business a motion to adjourn will be in order.

SECRETARY: Before that motion is put I would like to say that the Executive Committee at their meeting this evening directed the Entertainment Committee to arrange for the annual Smoker and Vaudeville for next month. It will probably be held at the German Club the same as last year. I would like to impress upon our members the fact that last year we had about 300 members present and about 200 guests. While we are always glad to have guests present, I do not believe we received more than a dozen applications during the year for membership from the two hundred guests, now if you bring a guest to the Smoker and Vaudeville on October 22d, try to get his application for membership. The Officers of the Club and members I am sure would like to see our Club grow to at least 1500 members during the coming year.

ON MOTION, Adjourned.

J. B. Anderson
Secretary.

PROCEEDINGS OF THE SOCIETY OF RAILWAY CLUB SECRETARIES.

The Society of Railway Club secretaries met in annual session June 12th, 1915, at the Hotel Marlborough-Blenheim, Atlantic City, N. J., Mr. J. B. Anderson, of The Railway Club of Pittsburgh, Chairman, presiding.

CLUBS PRESENT:

New York Railroad Club—Mr. Harry D. Vought, Secretary.

Central Railway Club—Mr. Harry D. Vought, Secretary-Treasurer.

Canadian Railway Club—Mr. James Powell, Secretary.

Richmond Railroad Club—Mr. F. O. Robinson, Secretary.

Southern & Southwestern Railroad Club—Mr. A. J. Merrill, Secretary.

The Secretary reported that the absence of Mr. W. E. Cade, Jr., Secretary of the New England Club was due to the serious illness of his sister.

The Minutes of the meeting held in 1914 were approved.

Under the head of Unfinished Business—The Secretary reported that the organization of the Society of Technical Associations' Secretaries, had finally been effected after a number of meetings during the past winter, and that in compliment to his having taken the initiative and the Society of Railway Club Secretaries having become the original sponsor, he had been elected President for the first year in spite of his protest and his earnest recommendation that some representative of greater prominence and influence, should be the chief executive of the Society.

Matters incidental to the work that had been done and completing the record thereof had been rounded out by the Secretary, Mr. Bradley Stoughton, in cooperation with the Executive Committee, Mr. George Conrad, Secretary of the American Association of Transportation and Accounting Officers, Mr. J. E. Alexander, Assistant Secretary of the American Railway Association, Mr. Edward Marburg of the Society of Testing Materials and Mr. Calvin A. Rice, Secretary, American Mechanical Engineers, whose assistance had been highly valuable.

The record was now being printed and would be widely distributed, and it was believed by those who had been active in its compilation that the ultimate effect would be many additions to

the membership of the Society and the attainment of the complete success anticipated by its founders.

Reports were received from members to whom had been referred the matter of inducing new clubs to affiliate with the Society.

Mr. Powell reported that the organization of a Club in Toronto had not reached a point of eligibility.

The Chairman, Secretary and Mr. Merrill had not been able to receive any reply from the Cincinnati Club's Secretary to invitation and letters, and on motion of Mr. Robinson, it was agreed to take up the matter with the other officers of the Club through the Secretary of the Society.

Mr. Merrill had been unable to find that there was any Club in Chattanooga.

Mr. Vought read the following correspondence exchanged after the last annual meeting with the Acting Secretary of the Western Club of Canada:

New York, July 27th, 1914.

Mr. Louis Kon,
Acting Secretary, Western Canada Railway Club,
Winnipeg, Man.

Dear Sir:

Mr. W. H. Rosevear, your Secretary, has directed me to write you for a list of subjects of papers discussed before your Club during the past year (and authors) and, if convenient, kindly furnish copy typewritten in the same form as appearing in copy of Index of Subjects herewith.

We were pleased to learn through Mr. Rosevear that you would affiliate with us. There is but a small assessment annually to the amount of $15.00 to cover current expenses of the Society and cost of printing the Index.

Will you also oblige me by advising the number of copies you will require to furnish each of your members with a copy.

Soliciting an early reply,

Very truly yours,

Harry D. Vought,
Secretary.

Winnipeg, Man., August 8th, 1914.

Mr. Harry D. Vought, Secretary,
New York Railroad Club,
New York City.

Dear Sir:

In reply to your favor of the 27th inst.:

I am sorry to advise you that it will be impossible for us to join at present the Society of Railway Club Secretaries, on account of the state of our finances.

I assure you that our Club fully appreciates the kind invitation you have extended to us, and we will not fail to take advantage of it at some later date.

Yours faithfully,

Western Canada Railway Club,
(Signed) Louis Kon,
Secretary, Pro Tem.

New Business—The Secretary reported that 7,350 copies of the Index of Subjects for last year were printed and distributed to members of Clubs represented in the Society, in addition to a number upon applications to the Secretaries from individuals and educational institutions made direct.

Mr. Anderson called attention to an innovation in the Proceedings of The Railway Club of Pittsburgh, by which each issue shows the subjects and authors, etc., before each Club each month, which had met with so much approval from officers and members of the Club, as a source of valued information that it had been made a permanent feature.

On motion of Mr. Merrill, it was agreed that other members of the Society recommend its adoption to their respective Executive Committees:

On motion of Mr. Powell, the payment of the customary bills for printing, stenographer and other current expenses of the Secretary's office was ordered.

On motion of Mr. Merrill, it was agreed to recommend to the Executive Committees of Clubs in the Society, the usual assessment of $15.00 for current expenses of the Society.

Following the discussion of questions relating to the affairs of the Society and the development of its further usefulness to its members, and the Clubs represented by them, the following officers were elected for the ensuing year and the Society adjourned:

Chairman: Mr. A. J. Merrill,

Vice-Chairman: Mr. W. E. Cade, Jr.,

Secretary-Treasurer: Mr. Harry D. Vought.

There being no further business the Society adjourned.

Respectfully submitted,

HARRY D. VOUGHT,
Secretary-Treasurer.

In Memorium

J. E. McGOUGH

Died January 27, 1915

W. A. SMITH

Died March 8, 1915

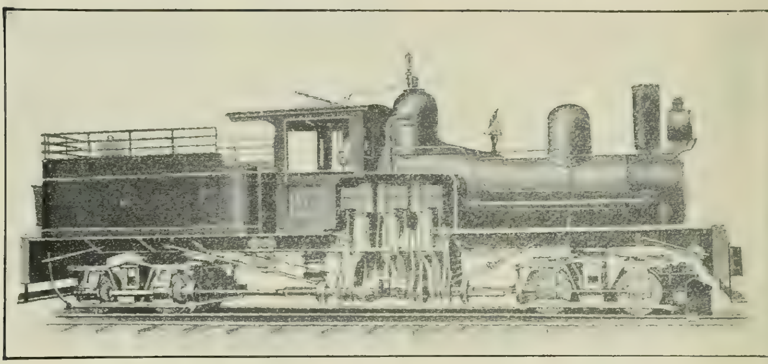
O. P. MECKEL

Died June 28, 1915

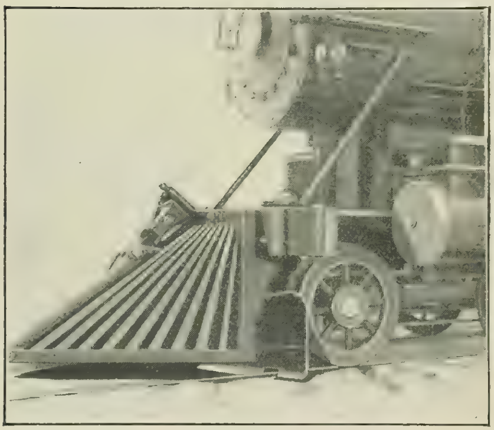
E. M. GROVE

Died August 26, 1915

Q. & C. FLANGERS
Q. & C. PLOWS



Ray Snow Flanger applied to SHAY Locomotive



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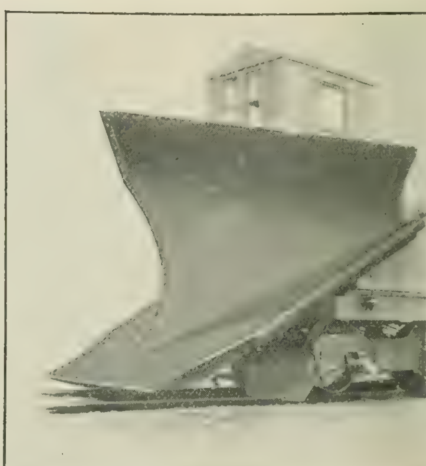

FOR SALE

OFFICIAL PROCEEDINGS

RAILWAY CLUB OF PITTSBURGH

$1.00 Per Year — 20¢ Per Copy

Vol. XIV. — OCTOBER 22, 1915 — No. 9.

Annual Meeting, Election of Officers, Smoker, Vaudeville, Names of Members.

INDEX—ADVERTISERS.

OFFICIAL PROCEEDINGS

OF

The Railway Club of Pittsburgh

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Meetings held fourth Friday of each month, except June, July and August.

PROCEEDINGS OF MEETING, OCTOBER 22, 1915.

The Annual Meeting of the Railway Club of Pittsburgh was called to order by President F. M. McNulty, in the auditorium of the German Club, 222 Craft Avenue, Pittsburgh, Pa., on Friday, October 22nd, 1915, at 8 o'clock, P. M.

The following gentlemen registered:

MEMBERS.

Adams Lewis
Alleman, C. W.
Allison, John
Amsbary, D. H.
Anderson, A. E.
Anderson, J. B.
Anderson, D. W.
Andresen, A. M.
Antes, Edwin L.
Babcock, F. H.
Balsley, J. T.
Barr, J. D.
Barth, J. W.
Battinhouse, John
Bealor, B. G.
Berghane, A. L.
Boehm, L. M.
Bohannon, G. L.
Bond, W. W.
Boyer, Chas. E.
Braun, Otto
Brantlinger, J. H.
Brown, A. D.
Brewer, W. A.
Bugle, G.
Burket, C. W.
Byron, A. W.
Calvin, A. W.
Carroll, F. E.
Cato, J. R.
Chapman, B. D.
Charles, J. L. Jr.
Christfield, J. G.
Clark, C. C.
Clark, Chas. H.
Cline, W. A.
Code, J. G.
Conner, W. P.
Cooper, F. E.
Cooper, J. H.
Cotton, A. C.
Copeland, T. T.
Courtney, D. C.
Crenner, J. A.
Cunningham, R. I.
Dalton, C. R.
Dambach, C. O.
Davis, A. G.
DeArment, J H.
Deem, G. M.
Dillon, S.
Eichenlaub, W. C.
Elkin, W. C.
Emery, E.
Eriksson, E. S.
Evans, E.
Evans, T. J.
Ewald, Wm.
Farquhar, L. C.
Ferguson, R. B.
Fluent, B. F.
Fogle, Emmett
Forcier, C. W.
Fox, H. K.
Frasher, J. D.
Frazier, E. L. Jr.
Freshwater, F. H.
Fulton, A. M.
Funk, S. R.
Gale, C. H.
Gearhart, J. A.
Geddes, J. R.

George, M. E.
Gies, G. E.
Goodwillie, E. E.
Graham, R.
Grewe, H. F.
Gross, C. H.
Guay, J. W.
Haggerty, J. F. Jr.
Hague, J. R.
Hair, H. J.
Hammond, H.
Hankele, E. W.
Harner, A. J.
Harper, R. C.
Harsch, A. M.
Haynes, J. E.
Heird, G. W.
Hepburn, M. J.
Henderson, J. W.
Henry, J. M.
Hettler, R. C.
Higgins, H. L.
Hink, G. L.
Hoffman, C. T.
Holt, Jas.
Howe, D. M.
Howe, Harry
Howe, W. C.
Huchel, E. W.
Huchel, H. G.
Huff, Geo. F. Jr.
Hughes, Jos. T.
Hunter, J. A.
Ickes, E. T.
Jameson, A. A.
Jenney, J.
Johnson, E. A.
Jordan, Jas. E.
Kelly, H. B.
Kelly, H. S.
Keptner, J. B.
Kinter, D. H.
Klein, R. A.
Knapp, A. D.
Knickerbocker, A. C.
Knight, E. A.
Koch, F.
Koll, J. F.
Krahmer, E. F.
Kummer, J. H.
Lanahan, J. S.
Lang, W. C.
Laughner, C. L.
Lawley, R. N.
Laylin, M. H.
Lehr, H. W.
Lobez, P. L.
Lockard, C. H.
Long, R. M.
Loughner, M. F.
Low, J. R.
Lowe, W. D.
Lyle, D. O.
Lynn, Saml.
Macfarlane, W. E.
Mackert, A. A.
Marshall, W. T.
Mason, R. L.
Maxfield, H. H.
Millar, C. W.
Miller, F. L.
Mitchell, A. G.
Mitchell, John Jr.
Mott, Saml. L.
Murphy, W. J.
McBurney, C. H.
McCann, J. P.
McClements, J. B.
McFarland, H. L.
McFeatters, F. R.
McGhee, W. S.
McKinstry, C. H.
McNaight, A. H.
McNulty, F. M.
McVicar, G. E.
Neal, J. T.
Neff, J. P.
Orbin, G. N.
Orchard, Chas.
Page, A. Jr.
Parke, F. H.
Patterson, J. E.
Pearson, A.
Penn, Wm.
Pennington, F. W.
Pennepacker, N. W.

Perry, W. E.
Pfeil, John
Pie, J. J.
Postlethwaite, C. E.
Pratt, I. D.
Proven, John
Rabold, W. E.
Ream, A. H.
Redding, D. J.
Reed, W. S.
Rehlim, T. G.
Reymer, C. H.
Reynolds, Thos.
Richers, G. J.
Richardson, L.
Ridley, R. C.
Roemer, W.
Roemer, Max
Rohn, W. B.
Rowand, T. A.
Runser, K. W.
Schaich, Wm. L.
Schauer, A. J.
Scheck, H. G.
Schultz, G. H.
Scott, R. T.
Seewald, J. H.
Sewell, H. B.
Shanahan, E. J.
Shaner, E. L.
Sheets, H. E.
Shourek, T. L.
Sigafoos, G.
Sleeman, W. C.
Smith, J. B.
Smith, C. P.
Smith, D. W.
Smith, F. C.
Smoot, W. D.
Snyder, F. I.
Snyder, J. R.
Snyder, J. W.
Stark, F. H.
Stevens, C. W.
Suckfield, G. A.
Sullivan, A. W.
Summers, J. M.
Swartz, H. E.
Taylor, H. G.
Thomas, J. H.
Toomey, J. J.
Trappe, W. C.
Turner, L. H.
Turner, Walter V.
VanDalsem, G. A.
Voight, A. J.
Vowinkle, F. F.
Waggoner, R. E.
Wegener, H.
Walter, W. A.
Walther, G. C.
Wardale, N. H.
Way, L. A.
Wessell, W. F.
White, F. L.
Wholey, V. A.
Wilder, H. W.
Williamson, J. A.
Williams, W. W.
Wilson, Thos. A.
Yungbluth, B. J.

VISITORS.

Adelsheim, L.
Anderson, D. C.
Anderson, R.
Austen, M. K.
Bannen, W. J.
Barrett, A.
Beach, D. F.
Beach, H. L.
Beaton, S. A.
Beckley, E. C.
Belsmeyer, L. A.
Betz, E. D.
Bosley, N. D.
Burford, W. F.
Burke, Wm.
Cady, W. M.
Campbell, B. S.
Campbell, M. M.

Campbell, Wm.
Carbaugh, H. W.
Carper, M. F.
Cato, W. C.
Chrystal, W. A.
Cleland, H. W.
Cochron, H. A.
Coleman, J. C.
Conlon, J.
Cooper, R. W.
Crane, W. R.
Crittenden, P. L.
Cunningham, C.
Cunningham, T. J.
Davidson, B. R.
Davis, E.
Datz, G. G.
Dempcy, R. H.
Donnelly, R. E.
Early, G. G.
Eaton, A. L. G.
Ecker, F. D.
Edgin, G. A.
Eisenberg, W. H.
Eilsdorf, D.
Emerick, H. M.
Emery, H. E.
Fincher, B. H.
Findlayson, W.
Fisher, H. L.
Flocker, N. J.
Flocker, R. M.
Follett, H. G.
Foreman, J. F.
Funk, H. T.
Fullerton, M.
Galbraith, R. C.
Gardner, R. C.
Greive, R. E.
Gumbert, C. K.
Haas, F.
Haggerty, J. F.
Hagerty, J. W.
Hahassey T.
Hamilton, Wm. H. Jr.
Harris, A. L.
Harshman, R. M.
Hazen, J. C.
Flemming, H. L.
Hesse, S. H.
Hoffman, J. M.
Huchel, Wm. J.
Irwin, H. E.
Jackson, C. A.
Jenny, A. S.
Johnson, J. F.
Jansen, Mr.
Kelleher, M. J.
Kelly, L. J.
Lewis, J. M.
Lewis, W. H.
Kennedy, H. O.
Kepperling, R.
Krepps, T. S.
Krieger, N.
Kuhlman, H.
Lament, G. F.
Lappin, C. W.
Laughlin, Jas.
Lawley, W. F.
Lehman, A. C.
Linn, Chas.
Long, W. H. H.
Lyons, R. S.
Macoubray, A. J.
Maginn, E. J.
Mangold, R. J.
Manns, G. A.
Manns, J. F.
Matchett, H. K.
Maxwell, F. R.
Meixner, G. F.
Miller, A.
Miller, B.
Mills, C. C.
Minor, L. L.
Moore, W. S.
Morrison, W. T.
Myers, C. A.
McCaffery, A.
McCune, F. W.
McGhee, J. A.
McLean, C. C.
McMonigle, E. E.
McNulty, F. B.
McNulty, R. M.

Nagel, H. D.
Neely, J. F.
Overstake, R.
O'Toole, M. J.
Parfitt, W.
Parlouski, S. J.
Parsons, G. L.
Perry, G. M.
Pertz, W. J.
Phillips, G. D.
Reese, J. L.
Reymer, R. E.
Reynolds, D.
Richardson, H. R.
Roberts, S. S.
Robinson, C. A.
Robinson, S. R.
Robinson, W. F.
Rubert, A. G.
Runetter, W. C.
Schaffnit, J. C.
Schauwecker, F.
Schrock, C.
Scott, D. J.
Seibel, E. L.
Shank, O. M.
Sheridan, T. F.
Sheetz, E. S.
Shook, A. A.
Smith, A. R.
Smith, Sion B.
Smith, Wm.
Stanton, J. W.
Stone, Dr. P. R.
Street, C. F.
Sugden, J. E. Jr.
Tarr, Wm. H.
Telford, E. W.
Theisen, W. C.
Thomosson, B. H.
Trager, C. W.
Tyshoff, K.
Vowinkel, G. A.
Wagner, E. A.
Whalen, J. A.
Wharton, J. E.
Wibner, A. J.
Wibner, A. R.
Willetts, H. G.
Williamson, R. A.
Wilt, L. O.
Winell, Karl
Wiskeman, E. C.
Wright, J. B.
Yawman, C. A.
Young, R. W. H.

The call of the roll was dispensed with, the record of attendance being had on the registration cards.

The reading of the minutes was dispensed with, the Proceedings having been already mailed.

The Secretary announced the following applications for membership:

Bosley, N. Dane, Machinist, P. & L. E. R. R., 1111 Dorhman Street, West Park, McKees Rocks, Pa. Recommended by F. E. Cooper.

Cox, Edward M., Representative of Cox Bros., Andrew Street and 14th Avenue, Munhall, Pa. Recommended by W. B. Lansberry.

Chrystal, W. A., Bookkeeper, Montour R. R., 8 Market Street, Pittsburgh, Pa. Recommended by W. T. Marshall.

Dixon, C. P., Assistant Train Master, Penna. R. R., 104 Campbell Street, Blairsville, Pa. Recommended by R. A. Klein.

Early, G. G., Assistant General Freight Agent, Wabash-Pittsburgh Ter. Ry., Wabash Building, Pittsburgh, Pa. Recommended by C. O. Dambach.

England, Alexander, Assistant Chief Engineer, Westinghouse Air Brake Co., 428 Biddle Avenue, Wilkinsburg, Pa. Recomemnded by P. L. Lobez.

Elk, George R., Assistant Train Master, Penna. R. R., 660 Evergreen Avenue, Millvale, Pa. Recommended by R. A. Klein.

Elsey, W. R., Draftsman, Penna. R. R., 4730 Blair Street, Hazelwood, Pittsburgh, Pa. Recommended by A. J. Voight.

Fields, Alfred C., Clerk, Pressed Steel Car Co., McKees Rocks, Pa. Recommended by Harry Howe.

Grieve, Robert E., Special Fireman, Penna. R. R., 1127 South Avenue, Wilkinsburg, Pa. Recommended by W. L. Hudson.

Gyllenflycht, T. E., Draftsman, Pressed Steel Car Co., 3335 McClure Avenue, Pittsburgh, Pa. Recommended by Harry Howe.

Huchel, Wm. J., Foreman Carpenters, Pressed Steel Car Co., 11th Street, West Park, McKees Rocks, Pa. Recommended by H. G. Huchel.

Holmberg, G. N., Inspector, Ajax Rail Anchor Co., 1204 McCormick Building, Chicago, Ill. Recommended by R. A. Klein.

Kelly, M. A., Traveling Salesman, Baird Machinery Co., 123 Water Street, Pittsburgh, Pa. Recommended by C. O. Dambach.

Krepps, T. S., Engineman, Penna. R. R., 2114 Eccles Street, Pittsburgh, Pa. Recommended by J. H. Brantlinger.

Laughlin, James, Foreman Tinners, P. & L. E. R. R., 719 School Street, McKees Rocks, Pa. Recommended by F. E. Cooper.

Leonard, D. E., Sales Manager, General Equipment Co., Oliver Building, Pittsburgh, Pa. Recommended by D. J. Redding.

Lipman, Michael, Supervisor, Penna. R. R., Blairsville, Pa. Recommended by R. A. Klein.

Loughridge, H. W., Assistant Foreman, P. & L. E. R. R., 911 Third Street, McKees Rocks, Pa. Recommended by F. E. Cooper.

Miller, A. T., Inspector, Pittsburgh Railways Co., 1003 Heberlon Street, Pittsburgh, Pa. Recommended by J. D. Barr.

Miller, William, Treasurer, Montour R. R., 1109 Oliver Building, Pittsburgh, Pa. Recommended by Geo. N. Riley.

Patton, Jas. G., Gang Foreman, P. & L. E. R. R., 1244 Church Avenue, McKees Rocks, Pa. Recommended by F. E. Cooper.

Rooney, E. S., District Sales Agent, Youngstown Sheet & Tube Co., 1626 Oliver Building, Pittsburgh, Pa. Recommended by D. H. Amsbary.

Shaffer, C. C., Requisition Clerk, General Storekeepers Office, P. & L. E. R. R., McKees Rocks, Pa. Recommended by J. A. Williamson.

Sheetz, E. S., Gang Foreman, P. & L. E. R. R., 322 Grove St., McKees Rocks, Pa. Recommended by F. E. Cooper.

Shelhart, Chas. R., Assistant Shop Clerk, Penna. R. R., 7480 Delmar Way, Swissvale, Pa. Recommended by W. E. Rabold.

Shank, O. M., Train Dispatcher, Wabash-Pittsburgh Ter. Ry., Wabash Building, Pittsburgh, Pa. Recommended by C. O. Dambach.

Waltz, M. H., Steam and Electrical Engineer, Wabash-Pittsburgh Ter. Ry., Wabash Building, Pittsburgh, Pa. Recommended by C. O. Dambach.

Wharton, J. E., Chief Clerk Stores Dept., Pittsburgh Railways Co., 7002 Kedron Street, Pittsburgh, Pa. Recommended by B. J. Yungbluth.

Winell, Karl, Draftsman, Pressed Steel Car Co., McKees Rocks, Pa. Recommended by E. S. Eriksson.

PRESIDENT McNULTY: As soon as these applications have been approved by the Executive Committee the gentlemen will become members.

The Secretary announced the death of the following members: Robert Finney, General Agent, B. & O. R. R., August 24, 1915; and Percy McCrory, Engineman, W. P. Ter. Ry., October 15, 1915

PRESIDENT: An appropriate memorial minute on the death of these members will appear in the next issue of the Proceedings.

The next in order will be the Annual Report of the Secretary.

Pittsburgh, Pa., October 22, 1915.

To the Officers and Members of
The Railway Club of Pittsburgh:

GENTLEMEN:

I beg to submit a statement of some of the events closing the fourteenth year of the Club:

During the year death has removed from our midst the following members: D. H. Haselett, J. E. McGough, W. A. Smith, O. P. Meckel, E. M. Grove, P. McCrory and Robert Finney.

The following is a summary of the membership, financial conditions, etc., for the year up to and including this meeting.

MEMBERSHIP

Reported last year	1070	
Received into membership during the year	142	
Reinstated	1	
Total		1213
Suspended for non-payment of dues	119	
Resigned	55	
Loss of address	7	
Removed by death	7	
Total		188
Present membership		1025

FINANCIAL

Receipts

In hands of Treasurer last year	$2,639.82	
From dues	2,211.00	
From advertising	1,981.16	
From sale of Proceedings and other sources	294.79	
Interest on Savings account of $1,000	43.28	
Interest on checking account	16.10	
Total		$7,186.15

Disbursements

Printing Proceedings, advance sheets, notices and postage for same	$2,408.29	
Hall rent, Lunch and Cigars for Club meetings	785.98	
Premium on bonds, Secretary and Treasurer	17.50	
Secretary's Expenses M. C. B. Convention	50.00	
Stereopticon light for illustrating papers	10.00	
Office stationery and supplies	114.79	
Entertainment of Members and guests	527.05	
Reporting Proceedings of meetings	135.00	
Secretary's salary year ending October 1915 and commission on advertising	798.11	
Messenger service	18.00	
Gratuity to Ex-Treasurer J. D. McIlwain	100.00	
Assessment, Society of Railway Club Secretaries	15.00	
Floral emblem	10.00	
Total		4,989.72
Balance in hands of Treasurer		$2,196.43

Respectfully submitted,

J. B. Anderson,

Secretary.

Approved:

L. H. Turner,

D. J. Redding,

F. R. McFeatters,

A. G. Mitchell,

Executive Committee.

PRESIDENT: We will now listen to the Annual Report of the Treasurer.

Pittsburgh, Pa., October 22, 1915.

To the Officers and Members of
The Railway Club of Pittsburgh:

GENTLEMEN:

I beg to submit the following report for the year ending October 22, 1915:

RECEIPTS

Balance on hand last year	$2,639.82	
Received from the Secretary during the year	4.486.95	
Interest on Savings account ($1,000.00)	43.28	
Interest on Checking account	16.10	
Total		$7,186.15

DISBURSEMENTS

Paid out on Secretary's vouchers		$4,989.72
Balance on hand		$2,196.43

Respectfully submitted,

F. H. STARK,
Treasurer.

Approved:

L. H. TURNER,
D. J. REDDING,
F. R. MCFEATTERS,
A. G. MITCHELL,
Executive Committee.

PRESIDENT: These reports will be referred to the Executive Committee for audit and approval.

Next we will have the report of the Executive Committee on the result of the ballot for election of Officers for the ensuing year beginning November 1st.

MR. D. J. REDDING: On behalf of Mr. Turner, Chairman of the Executive Committee, I ask leave to submit the following report: It is hardly necessary to mention the totals

except to say that with the exception of a few scattering votes the "slate was unanimously elected." The total number of votes cast was 278. The lowest number of votes received by any candidate was 272.

President—F. M. McNulty, Supt. M. P. & R. S. Monongahela Connecting R. R.

First Vice-President—J. C. Code, General Manager, Wabash-Pittsburgh Terminal Ry.

Second Vice-President—H. H. Maxfield, Master Mechanic, Penna. R. R.

Secretary—J. B. Anderson, Chief Clerk to Supt. Motive Power, Penna. R. R.

Treasurer—F. H. Stark, General Supt. Montour R. R.

Executive Committee—L. H. Turner, Supt. Motive Power, P. & L. E. R. R.; D. J. Redding, Assistant Supt. Motive Power, P. & L. E. R. R.; F. R. McFeatters, Supt. Union R. R.; A. G. Mitchell, Supt. Monon. Division, Penna. R. R.

Finance Committee—D. C. Noble, President, Pittsburgh Spring & Steel Co.; E. K. Conneely, Purchasing Agent, P. & L. E. R. R.; C. E. Postlethwaite, Manager Sales, Pressed Steel Car Co.; L. C. Bihler, Traffic Manager, Carnegie Steel Co.; Walter V. Turner, Assistant Manager, Westinghouse Air Brake Company.

Membership Committee—D. M. Howe, Manager, Jos. Dixon Crucible Co.; Chas. A. Lindstrom, Assistant to President, Pressed Steel Car Co.; A. Stucki, Engineer; C. O. Dambach, Supt. Wabash-Pittsburgh Terminal Ry.; Frank J. Lanahan, President, Fort Pitt Malleable Iron Co.; Harry Howe, Inspector of Castings, Pressed Steel Car Co.; R. L. Kleine, Chief Car Inspector, Penna. R. R.

Entertainment Committee—Stephen C. Mason, Secretary, The McConway & Torley Co.; R. H. Blackall, Railway Supplies, D. H. Amsbary, District Manager, Dearborn Chemical Co.

PRESIDENT: It has been customary to call upon the newly elected officers to respond with a few well chosen remarks. But owing to the length of the Vaudeville programme that has been prepared for you this evening, and also to the further fact that with one exception the elections have been re-elections, it would seem wise to dispense with the oratory with one exception. Mr. Walter V. Turner of the Westinghouse Air Brake Company is a new member in the official family, and we will be pleased to hear from him, provided he keeps away from the subject of air brakes on this occasion.

MR. WALTER V. TURNER: Mr. President and fellow-members of The Railway Club; I appreciate very highly the honor of being elected to membership on one of the Committees of this Club. And I not only appreciate it, but I am pleased to be given the opportunity to be of some service to such an organization as this. I assure you that I will do my best to perform well every duty which I may called upon to do.

MR. A. G. MITCHELL: I move that the remarks of Mr. Turner be acepted as the response of all the other elected officers.

The motion was duly seconded and carried with enthusiastic unanimity

PRESIDENT: This finishes the regular business of the meeting, and if there is nothing further to be brought before the Club at this time we will turn over the balance of the evening to the Entertainment Committee, of which Mr. D. H. Amsbary is acting as Chairman.

MR. AMSBARY: Mr. President and Gentlemen: The Entertainment Committee have this year gone to considerable expense and effort to get up a programme that we hope will meet with your approval. We wish to call your attention especially to the third number on the programme. Keep your eyes open.

The following program was then carried out:

Moving Picture ....(cartoon comic)

Comedy Magicians ....DeKorSee & AnDerSon

Moving Picture ....(Sea Nymphs)

Musical Trio........Harry Murdoch, Tom Francis, & Jean Locklin
(Courtesy of H. Murdoch & Co.—Babbitt Metals).

Moving Picture ....(Comic)

Music Specialty (extraordinary).............. Mina L. McNemry
George L. McNemry

☞ Moving Pictures by courtesy of Dearborn Chemical Co.

Orchestra Music—Julius Frey

The programme was well received by the largest audience that has ever assembled at an Annual Meeting of the Club. The auditorium was filled to overflowing and many stood throughout the whole evening's entertainment.

A particularly interesting feature was a series of motion pictures of wild bird life, showing birds nesting, bringing food and feeding their young, etc.

Each member and guest present was given upon his entrance into the Auditorium a smokers package, containing pipe, tobacco, cigars and stogies.

Taken all together, there has been no more delightful or successful meeting of the Club in its entire history. At the close of the entertainment this thought was voiced by Mr. Stark in a motion of thanks.

Mr. F. H. STARK: It is but simple justice that we give formal expression to the Committee who prepared, and the friends who helped in our entertainment this evening. It was both thoughtfully and efficiently handled and deserves high praise. And we can vote our appreciation the more heartily because of the compliment the Committee paid to our taste in the unusually high grade of the entertainment presented. I would therefore move a rising vote of thanks to Mr. Amsbary and his Committee and to the friends who assisted in our entertainment.

The motion was duly seconded and carried by unanimous vote.

At the conclusion of the programme the assembly adjourned to the Rathskeller where refreshments were served and the remainder of the evening—and some of the morning—spent in social enjoyment.

J B Anderson
Secretary.

CONSTITUTION

Article I.

The name of this organization shall be "The Railway Club of Pittsburgh."

Article II.

OBJECTS.

The objects of this Club shall be mutual intercourse for the acquirement of knowledge, by reports and discussion, for the improvement of railway operation, construction, maintenance and equipment, and to bring into closer relationship men employed in railway work and kindred interests.

Article III.

MEMBERSHIP.

Section 1. The membership of this Club shall consist of persons interested in any department of railway service or kindred interests, or persons recommended by the Executive Committee upon the payment of the annual dues for the current year.

Sec. 2. Persons may become honorary members of this Club by a unanimous vote of all members present at any of its regular meetings, and shall be entitled to all the privileges of membership and not be subject to the payment of dues or assessments.

Article IV.

OFFICERS.

The officers of this Club shall consist of a President, First Vice-President, Second Vice-President, Secretary, Treasurer, Finance Committee consisting of five members, Membership Committee consisting of seven members, Entertainment Committee consisting of three members, and an Elective Executive Committee of three or more members who shall serve a term of one year from the date of their election, unless a vacancy occurs, in which case a successor shall be elected to fill the unexpired term.

Article V.

DUTIES OF OFFICERS.

Section 1. The President shall preside at all regular or special meetings of the Club and perform all duties pertaining

to a presiding officer; also serve as a member of the Executive Committee.

Sec. 2. The First Vice-President, in the absence of the President, will perform all the duties of that officer; the Second Vice-President, in the absence of the President and First Vice-President, will perform the duties of the presiding officer. The First and Second Vice-President shall also serve as members of the Executive Committee.

Sec. 3. The Secretary will attend all meetings of the Club or Executive Committee, keep full minutes of their proceedings, preserve the records and documents of the Club, accept and turn over all moneys received to the Treasurer at least once a month, draw cheques for all bills presented when approved by a majority of the Executive Committee present at any meetings of the Club, or Executive Committee meeting. He shall have charge of the publication of the Club Proceedings and perform other routine work pertaining to the business affairs of the Club under the direction of the Executive Committee.

Sec. 4. The Treasurer shall receipt for all moneys received from the Secretary, and deposit the same in the name of the Club within thirty days in a bank approved by the Executive Committee. All disbursements of the funds of the Club shall be by cheque signed by the Secretary and Treasurer.

Sec. 5. The Executive Committee will exercise a general supervision over the affairs of the Club and authorize all expenditures of its funds. The elective members of this Committee shall also perform the duties of an auditing committee to audit the accounts of the Club at the close of a term or at any time necessary to do so.

Sec. 6. The Finance Committee will have general supervision over the finances of the Club, and perform such duties as may be assigned them by the President or First and Second Vice-Presidents.

Sec. 7. The Membership Committee will perform such duties as may be assigned them by the President or First and Second Vice-Presidents, and such other duties as may be proper for such a committee.

Sec. 8. The Entertainment Committee will perform such duties as may be assigned them by the President or First and

Second Vice-Presidents and such other duties as may be proper for such a committee.

Article VI.

ELECTION OF OFFICERS.

Section 1. The officers shall be elected at the regular annual meeting as follows, except as otherwise provided for:

Sec. 2. Printed forms will be mailed to all the members of the Club, not less than twenty days previous to the annual meeting, by the elective members of the Executive Committee. These forms shall provide a method, so that each member may express his choice for the several offices to be filled.

Sec. 3. The elective members of the Executive Committee will present to the President the names of the members receiving the highest number of votes for each office, together with the number of votes received.

Sec. 4. The President will announce the result of the ballot and declare the election.

Sec. 5. Should two or more members receive the same number of votes, it shall be decided by a vote of the members present, by ballot.

Article VII.

AMENDMENTS.

Amendments may be made to this Constitution by written request of ten members, presented at a regular meeting and decided by a two-thirds vote of the members present at the next regular meeting.

BY-LAWS

Article I.

MEETINGS.

Section 1. The regular meetings of the Club shall be held at Pittsburgh, Pa., on the fourth Friday of each mnoth, except June, July and August, at 8:00 o'clock P. M.

Sec. 2. The annual meeting shall be held on the fourth Friday of October each year.

Sec. 3. The President may, at such times as he deems expedient, or upon request of a quorum, call special meetings.

Article II.

QUORUM.

At any regular or special meeting nine members shall constitute a quorum.

Article III.

DUES.

Section 1. The annual dues of members shall be Two dollars, One dollar of which to provide light refreshments for each meeting, payable in advance on or before the fourth Friday of September each year.

Sec. 2. The annual subscription to the printed proceedings of the Club shall be at the published price of One Dollar.

Sec. 3. At the annual meeting members whose dues are unpaid shall be dropped from the roll after due notice mailed them at least thirty days previous.

Sec. 4. Members suspended for non-payment of dues shall not be reinstated until all arrearages have been paid.

Article IV.

ORDER OF BUSINESS.

1—Roll call.
2—Reading of the minutes.
3—Announcements of new members.
4—Reports of Committees.
5—Communications, notices, etc.
6—Unfinished business.
7—New business.
8—Recess.
9—Discussion of subjects presented at previous meeting.
10—Appointment of committees.
11—Election of officers.
12—Announcements.
13—Financial reports or statements.
14—Adjournment.

Article V.

SUBJECTS—PUBLICATIONS.

Section 1. The Executive Committee will provide the

papers or matter for discussion at each regular meeting.

Sec. 2. The proceedings or such portion as the Executive Committee may approve shall be published (standard size, 6x9 inches), and mailed to the members of the Club or other similar clubs with which exchange is made.

Article VI.

The stenographic report of the meetings will be confined to resolutions, motions and discussions of papers unless otherwise directed by the presiding officer.

Article VII.

AMENDMENTS.

These By-Laws may be amended by written request of ten members, presented at a regular meeting, and a two-thirds vote of the members present at the next meeting.

RAILWAY CLUB NOTES.

The following subjects were presented and discussed by the several Railway Clubs during the month of October as noted below:

New York Railroad Club, Harry D. Vought, Secretary, 95 Liberty Street, New York, N. Y.

SUBJECT—"The Value of Motor Cars" by W. R. McKeen.

New England Railroad Club, Wm. E. Cade, Jr., Secretary, 683 Atlantic Avenue, Boston, Mass.

SUBJECT—"The Architect in Railroading" by L. G. Morphy.

Canadian Railway Club, Jas. Powell, Secretary, Chief Draftsman G. T. R., Montreal, Canada.

SUBJECT—"Electric Lighting of Railway Cars" by E. S. McNab.

Richmond Railway Club, F. O. Robinson, Secretary, c/o C. & O. Ry., Richmond, Va.

SUBJECT—"Signaling in General" by H. W. Griffin.

St. Louis Railway Club, B. W. Frauenthal, Secretary, Union Station, St. Louis, Mo.

SUBJECT—"Fires From Locomotive Sparks" by L. W. Wallace.

Copies of the above papers can be had upon application to the Secretary at the address given, for a nominal price.

MEMBERS.

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Elrama, Pa.

Albree, Chester B.,
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B. & O. R. R.,
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Bowden, T. C.,
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Machine Shop,
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Morgantown, W. Va.

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C. C. to Genl. Manager,
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Brown, John T., Jr.,
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Gross and Yew Sts.,
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Round House Foreman,
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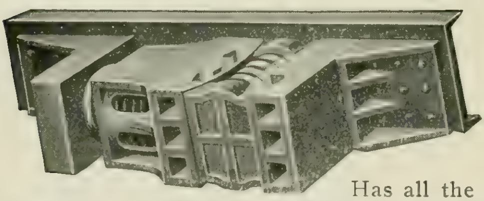

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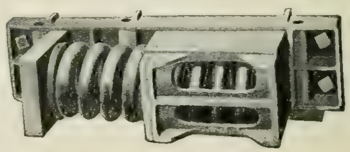

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